DOCUMENT RESUME

ED 457 379 CE 082 419

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TITLE Training, Innovation and Business Performance: An Analysis of the Business Longitudinal Survey.
INSTITUTION National Centre for Vocational Education Research, Leabrook (Australia).
ISBN ISBN-0-87397-737-8
PUB DATE 2001-00-00
NOTE 83p.
AVAILABLE FROM National Centre for Vocational Education Research, 252 Kensington Road, Leabrook, South Australia 5068, Australia (cat no. 635; $25.30 Australian). Tel: 08 8333 8400; Fax: 08 8331 9211; e-mail: vet_req@ncver.edu.au; Web site: http://www.ncver.edu.au. For full text: http://www.ncver.edu.au/research/proj/nr9033.pdf.
PUB TYPE Reports - Research (143)
EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Change; Data Interpretation; Developed Nations; Education Work Relationship; Evaluation Methods; Foreign Countries; Improvement; Influences; *Innovation; Internet; Longitudinal Studies; *On the Job Training; *Organizational Development; *Outcomes of Education; Postsecondary Education; *Relevance (Education); Research and Development; *Small Businesses; Statistics; Technology Transfer; Theory Practice Relationship
IDENTIFIERS *Australia; Return on Investment

ABSTRACT

This paper uses the Australian Bureau of Statistics' Business Longitudinal Survey to explore relationships between training, innovation, and firm performance for Australian businesses with less than 200 employees. The longitudinal nature of the data is used to test various hypotheses about the nature of the link between training, business changes, and innovation. The paper finds strong evidence of changes in training being associated with the occurrence of innovations over the period of the survey and, to a minor extent, of a link between innovation and the level of on-the-job training being provided in the final year of the survey. These two findings offer some support to sustain a claim that training in itself brings about innovation: (1) firms that undertake formal business or strategic planning are both higher trainers and higher innovators; and (2) using Internet-related activities as an applied example of innovation, evidence is found of a positive link between increases in management training and the adoption of e-commerce. The paper points out, however, that the analysis is significantly constrained by the quality of the data--in particular to the instruments used for measuring training and also for measures of innovation, both of which are far from ideal. (Contains 77 references.) (KC)

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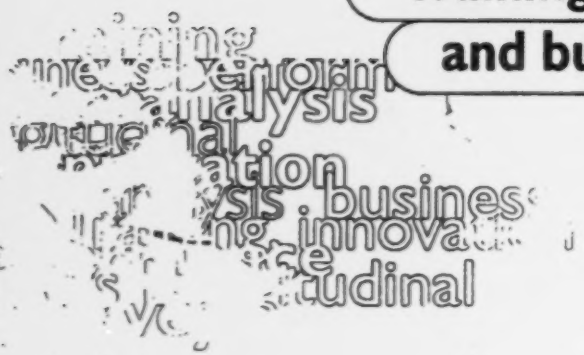

An **analysis** of the **Business Longitudinal Survey**

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Training, innovation and business performance

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A Michael Dockery

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ISBN 0 87397 737 8 print edition

ISBN O 87397 738 6 web edition

TD/TNC 66.74

Published by NCVER

ABN 87 007 967 311

252 Kensington Road, Leabrook, SA 5068
PO Box 115, Kensington Park, SA 5068, Australia

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Acknowledgements

I would like to acknowledge the helpful guidance and advice of staff from the Curtin Business School, Professors Geoff Crockett and Peter Kenyon, throughout this research. Paul Koshy and Therese Jefferson, of the Institute for Research into International Competitiveness (IRIC), provided research assistance at various stages with their usual high degree of professionalism. I would particularly like to acknowledge the valuable and thoughtful comments by several anonymous reviewers provided by the National Centre for Vocational Education and Research. Their comments have resulted in substantial improvements to the paper. Responsibility for any error or omission rests with the author.

Executive summary

This paper utilises the Australian Bureau of Statistics' Business Longitudinal Survey (BLS) to explore relationships between training, innovation and firm performance for Australian businesses with less than 200 employees. The paper is structured to consecutively concentrate on the determinants of training practices, innovation and finally measures of firm performance. The longitudinal nature of the data is used to test various hypotheses about the nature of the link between training, business changes and innovation. Can a firm foster greater innovation by providing a greater level of training, or is training simply a part of the process for implementing already determined business changes or innovations? Are training commitment and innovation joint characteristics of a distinctive progressive firm culture?

Different types of training—such as technical, on-the-job, structured and managerial training —are not substitutes but complements, and firms implementing training changes are likely to undergo further similar changes in following years. This is suggestive of the existence of 'high-training' and 'low-training' cultures across firms, at least for limited periods. There is strong evidence that training often occurs in tandem with other business changes. It seems clear that training is used as one of the major tools by which the implementation of new technology, work practices and business strategies is facilitated. Evidence that training is a causal factor in bringing about change that otherwise wouldn't have occurred is weak.

Analysis of the determinants of which firms are more likely to report an innovation reveals a 'large firm' effect consistent with an extensive economic literature arguing that larger firms (or efficient networks) offer synergies in innovation and in research and development. However, research-and-development-based variables appear to be very poor proxies for innovation, despite their common use within the literature for that purpose. Strong evidence appears of changes in training being associated with the occurrence of innovations over the period of the survey, and to a minor extent of a link between innovation and the level of on-the-job training being provided in the final year of the survey. We could not, however, claim to have found adequate support to sustain a claim that training in itself brings about innovation. Two findings that do offer some support for this notion are:

- Firms which undertake formal business or strategic planning are both higher trainers and high innovators. Moreover, increases in management training were found in several models to precede the implementation of business planning. This is consistent with management training providing mangers with the capacity to implement formal planning processes, which in turn appears to promote innovation.
- Using internet-related activities as an applied example of innovation, evidence is found of a positive link between increases in management training and the adoption of e-commerce. More importantly, three indicators of the take-up of internet-related activities were positively associated with the level of structured training provided in the following year, suggesting a high level of formal training may be a component of an innovative firm culture.

The analysis is significantly constrained by the quality of data. This applies in particular to the instruments used for measuring training, and also for measures of innovation, both of which are far from ideal. A strong bias seems to be present, for example, in respondents' reporting of major increases in training for the firm. Attempts to further relate training and innovation variables to business performance outcomes have been even less successful, again partly reflecting limitations in the data. Before any claims can be made in this regard, considerable

improvements in the modelling of firm performance using the BLS data will need to be achieved.

The research has served to re-emphasise the many problems that have confounded economists in attempting to analyse the benefits and impacts of training, particularly in relation to issues of the measurement of training and the ability of survey data to support the analysis of associations between training and firm performance. The findings here suggest that one fruitful avenue may be to shift the focus of the research away from viewing training as a 'general' input to one that is purpose-specific. The impacts of training could then be evaluated against the relevant objectives, rather than more general performance measures.

Introduction

Considerable evidence has been amassed to demonstrate that Australia lags behind comparable advanced countries in terms of the level of investment in training, and particularly in formal vocational education and training (VET). The oft-cited comparison is with Germany, where around three-quarters of the labour force have completed an apprenticeship or some other form of post-secondary vocational training as opposed to less than half in Australia (see Dockery 1996). Some international studies provide evidence that significant gains in productivity and competitiveness can be attributed to greater levels of formal VET (for example, Prais et al. 1989, Mason et al. 1992).

Over recent decades Australian governments have implemented a number of major reforms in an attempt to increase the level of training in Australian industry. These include the Commonwealth Rebate for Apprentices in Full-time Training (CRAFT) rebate scheme, the Training Guarantee, award restructuring, the Australian Traineeship System, multiskilling, competency-based training, the development of a competitive market for training providers and, most recently, the New Apprenticeship System.

These measures appear to have had only limited success. A prerequisite to enhancing Australia's training culture is for employers to be convinced that they will benefit from investing in training, but Australian evidence on the returns to the firm from investing in training is relatively scant and the case for high positive returns is far from compelling. A series of studies by the Centre for Labour Market Research has suggested that, contrary to economic theory, firms actually incur a net cost in providing apprenticeships and traineeships (Dockery et al. 1997). Conversely, recent pilot studies of a range of different evaluation techniques for Australian firms suggested high returns to investments in training (Blandy et al. 2000).

Overseas studies continue to highlight human resource and training practices as important determinants of improvements in firm performance. Moreover, in the so-called 'global knowledge economy' the importance of training is seen to take on new dimensions. Survival in the new economic order depends upon 'learning to become a learning organisation'. Vital ingredients in any strategy to become an adaptive, learning organisation will include the links between training and:

- the take-up/implementation of new technology
- efficient utilisation of technology
- adoption of new work and management practices
- companies' ability to respond to changing environments
- innovation
- research and development

This study seeks to address some of these issues using unit record data from the Australian Bureau of Statistics' (ABS) Business Longitudinal Survey (BLS), which tracked around 5600 firms over a four-year period. The main focus is on exploring the links, if any, between training and innovation in the culture of firms and, in turn, the implications for firm performance. The following section provides a background review of the literature relating to the links between training investment and firm performance. The third section contains

information on the BLS, the available data and an initial descriptive picture of training in Australian businesses as derived from the data. In the following section we seek to identify the factors associated with different training practices, in terms of the level of training provided by the firm and changes in the level of training. Measures of innovation are examined in the chapter which follows, with a focus upon the synergies between innovation and training variables. Factors associated with firms' take-up rates of internet applications and of e-commerce are then modelled as an applied example of the diffusion of an innovation. The second-to-last section attempts to identify factors contributing to, or impacting upon, firm profitability and other measures of performance, including the role of training and innovation. A summary of the major findings and a concluding discussion are provided in the final chapter.

Training and firm performance: A review

There is a large body of research literature outlining the possible benefits of education and training. Included in this are studies of how society benefits overall from education and training (via calculations of the net social rate of return) and how the costs and returns are distributed between individuals, firms and the public sector. A common approach has been to view education and training as a form of 'capital' investment which leads to enhanced productivity. This approach, known broadly as the human capital approach, has a long history in economics. It has been argued that 'the idea that education and training may be treated as capital is at least as old as the *Wealth of nations* (Reder 1982) while Paulin (1999) traces it to Sir William Petty, who in seventeenth-century England attempted to estimate the 'value of the people'.

Though not conclusive, there is substantial evidence within the literature of links between education and training and subsequent benefits to individuals derived through improved labour market rewards in the form of higher employment rates and higher earnings. It appears likely that this reflects, to some extent, improved productivity derived from education and training (see for example Brown 1990; Booth 1991; Mincer 1993; Lillard & Tan 1992; Lynch 1996; Duncan & Hoffman 1996; Freeman 1996; Dockery & Norris 1996). A second area of literature attempts to establish empirically the relationship between education and training and benefits to society. In developing economies, improved education about nutrition can lead to benefits in reduced incidences of illness, reduced health care costs and improved life expectancy (see for example Schultz 1945, 1961, 1979). In developed economies the linkages between training, education and social benefits can be more difficult to identify, although some strong correlations may be found (Becker 1980).

This study is concerned with the benefits that accrue to firms who invest in the training of their employees and the role of innovation in that nexus. There exists a relatively limited, but significant literature focussing upon this aspect of training. Studies that measure the relationship between training and business performance are the main focus of this review. First, we look more generally at studies that have sought to identify differences in performance between firms and the ways in which firm performance has been measured.

The performance of firms

The essential measures of firm performance relate to profitability. In economic theory, the optimal allocation of resources is achieved through firms pursuing activities offering the highest rate of return on investment, or the greatest ratio of the value of outputs to the value of inputs. This optimisation outcome rests upon the assumptions of perfect markets, including the full costing of all inputs and externalities, and zero costs to market entry. The profit-maximisation goal is shared by the firm's owners or shareholders, although these agents can also be expected to seek to exploit advantages which arise through market imperfections—'abnormal profits'—such that maximising profits need not equate to optimal resource allocation. Hence a range of other performance measures relating to public policy objectives can also be identified, such as employment or export growth.

A range of accounting or economic measures are used to assess profits, including the rate of return on equity, return on assets and the ratio of output price to marginal costs (see, for example, Northwood 1999; McDonald 1999; Feeny & Rogers 1998). When a temporal dimension is added, short-term profit maximisation may not be consistent with long-run strategies. Hence proxy measures associated with long-run profitability are also commonly used in assessing firm performance, such as market share, sales growth or even research and development expenditure. Feeny and Rogers (1998) find that, even among accounting measures of profit, the choice of measure can give significantly different pictures of firm performance.

There is of course a very large number of factors that can affect the performance of firms and these have been studied extensively overseas. McDonald notes that almost all of the literature focusses on manufacturing activities, principally because of the availability of important industry-level variables that influence profitability, such as industry concentration and import intensity (1999, p.117). The major variables found to be linked with profitability include aggregate economic conditions, market share, industry concentration, import intensity, the degree of unionisation of the workforce, the industrial relations climate and institutional framework. McDonald (1999) confirms the presence of these effects for Australian manufacturing firms using IBIS firm-level data from 1983 to 1995. McDonald (1999) and Northwood (1999) find lagged values of the dependent variables to be important in their estimations, suggesting a degree of persistence in profit performance over time. Much of the other recent Australian evidence has come from the Melbourne Institute's Performance of Australian Enterprises project using data from either the Australian Workplace Industrial Relations Survey (AWIRS) or the Business Longitudinal Survey (Feeny 2000; Feeny & Rogers 1998, 1999; Loundes 1999; Rogers 1998a, 1999).

The positive link between market share or industry concentration and profitability has been attributed to greater incentives for collusion (the structure–conduct–performance paradigm) and a range of other explanations relating to efficiency of scale or reduced transaction costs. Feeny and Rogers (1999) review the evidence on this relationship, which has been found to be weaker in Australia than in other countries. This review and their own preliminary empirical analysis based on IBIS panel data for 722 large Australian firms find support for the presence of such a relationship. The evidence is less clear regarding the effects of diversification versus specialisation in a firm's activities. However, using Australian Tax Office data for a very large number of 'tax entities', Feeny later finds 'little evidence of the expected positive relationships between entity profitability and industry concentration' (2000, p.24). A positive association with profitability was identified for capital intensity, but conflicting evidence for measures attempting to indicate the strength of barriers to entry. Contrary to previous literature, Feeny (2000) also finds a U-shaped relationship between market share and profitability.

Northwood (1999) has used data from the full four years of the Business Longitudinal Survey to empirically investigate firm performance. She uses return on equity, profit margin and return on assets as the measures of firm performance to be explained via ordinary least squares regression, with profit margins offering the best estimation results. Industry and State dummies and the ratio of liabilities to assets (-) were found to be the most important explanatory factors. Performance was also found to be significantly correlated to lagged profits (+), exports (-), foreign ownership (+), age of the firm (+), real wages (-), the number of 'business practices' used (+) and, in some models, training expenditure as a proportion of total expenses (+). A model based on differences in the variables was less robust, leading Northwoood to suggest the BLS data 'is not well suited to the modelling of within-firm changes overtime' (1999, p.23).

Productivity and industrial relations

As a physical measure of the ratio of outputs to inputs, a strong correspondence is expected between measures of productivity and its financial counterpart of profitability. Labour, capital and 'total factor' productivity are therefore also useful measures of firm performance. As discussed below, training is primarily intended to enhance labour productivity. A common

focus of studies investigating the determinants of labour productivity differences between firms is the impact of industrial relations arrangements.

Rogers (1998a) uses data from the first year of the BLS to analyse labour productivity in Australian firms. Labour productivity is modelled as value-added per estimated full-time equivalent worker. Labour productivity is found to vary considerably between industries, much of which can be attributed to different levels of capital intensity and firm sizes in accordance with the standard Cobb–Douglas production function framework. But it also varies substantially within industries. Rogers also presents tentative evidence that labour productivity is higher in exporting firms, 'innovating' firms, and those which utilise government programs.

Loundes (1999), Hawke and Drago (1998) and Drago and Wooden (1992) have investigated labour productivity using data from the AWIRS. While US studies have generally found a detrimental effect of unions on productivity, the Australian evidence is unclear. Loundes (1999) finds no significant association between the presence or number of unions present and productivity, but some positive association between union density and labour productivity. She also finds weak evidence of a positive effect of training, with management/employee relations being an important factor in promoting workplace productivity.

Hawke and Drago (1998) investigate firm performance in the context of assessing the impact of the introduction of enterprise agreements. In line with the stated objectives for this policy, Hawke and Drago test for correlations between enterprise agreements and measures of workplace productivity and performance. In the AWIRS, managers were directly asked about the impact of enterprise agreements, and on average, the pattern of responses indicated that enterprise agreements did improve profitability, labour productivity and the quality of products and services in the opinion of managers. However, this finding did not bear through in fuller empirical models of direct measures of performance. In these models relatively few independent variables included by the authors were found to be significant; namely, union, industry and occupation effects.

Measuring benefits to firms from training and education

Human capital theory postulates that individuals can improve their productive capacity, and hence their expected returns from employment, by investing resources in education and training. Similarly, firms may improve their expected returns by investing in the education and training of their workforce. Since firms are well placed to provide training and to benefit from the higher productivity it brings, it follows that the costs and benefits of investments in education and training are shared between individuals and firms.

Becker (1980) distinguished between 'general' and 'specific' training. General training produces skills relevant to all or many firms and can be expected to increase an individual's productivity and thus wage in a range of occupations and industries. That is, the benefits of general training are portable between firms. Specific training increases an individual's productivity in one firm only and is not transferable to other firms. In this case the firm will capture all of the benefits of training because the individual cannot use those skills to obtain a more lucrative position in another firm. Thus it is expected that firms pay for training in specific skills. In reality, most training has both specific and general components and individuals have a combination of specific and general skills. Relaxing the dichotomy, human capital theory predicts that the cost of financing training is apportioned between the individual and employer according to the degree of generality of the training.

Following the human capital approach, firms may be expected to benefit from education and training if improvements in productivity are not completely matched by increased wages; that is, if part of the gains in productivity are retained by the firm. However, assessing the returns from training to firms is complex. While it is possible conceptually to model the role of training in relation to business performance, empirically establishing the nature of specific

linkages and assessing the returns to training poses an array of challenges. These challenges relate to both the availability of suitable data and the fact that training is one variable in a complex array of organisational variables which can influence productivity. Consequently, 'the value of training in improving productivity has been asserted more often that it has been assessed' (OTFE 1998).

In an assessment of studies examining the returns on investment in training, Billet and Cooper (1997) observe that training has frequently been undertaken as an integral component of broader structural change and innovation within firms (see also Kay et al. 1992; Baker & Wooden 1995; Catts 1996; Coopers & Lybrand 1994; Ichniowski et al. 1996). Therefore, while the goal of increased productivity may be a reason for implementing training and education programs, it may be difficult to attribute productivity outcomes solely to this cause. Changes in productivity are likely to reflect the aggregated results of training and new work practices.

A range of approaches has been used in attempting to determine the returns achieved by firms from investment in training and education. These can grouped under the following categories:

- qualitative surveys of the perceived benefits derived from training
- comparing levels of wage growth with quantitative data on productivity in firms
- comparing quantitative data on productivity in an individual firm
- comparing quantitative data on productivity between firms with differing levels of training
- comparing quantitative data on productivity between regions or industries with differing levels of training

Below we review of the findings of studies under these headings. Bartel (2000) also provides a useful recent review, focussing on the 'case study' and 'large sample' quantitative approaches to estimating employers' returns to investment in training.

Qualitative surveys of the perceived benefits derived from training

Surveys of managerial staff may reveal advantages from training which are not apparent by reference to productivity statistics. For example, enhanced flexibility and problem-solving ability are possible benefits from education and training programs which may not translate into higher productivity or sales in the short term. In addition, they can reveal the extent to which managers believe that training, and not some other issue, is the relevant cause of changes in productivity.

A number of surveys have suggested a rather skeptical view of the benefits of training among Australian managers. Managers often see external training as 'not relevant', 'too theoretical' and 'without immediate benefit to the business'. Surveys have also identified a lack of understanding or knowledge about training structures and reforms, particularly among smaller firms (Billet & Cooper 1997, pp.8–9). Surveys of employers' attitudes towards apprenticeships and traineeships undertaken by the Centre for Labour Market Research reveal that employers generally believe training an apprentice or trainee to be a net benefit to the firm over the full period of the training. However, attempts to quantify the net costs revealed precisely the reverse (Dandie et al. 1997; Dockery et al. 1997).

Potential sources of benefits from training identified by managers include improved occupational health and safety outcomes, greater motivation, lower staff turnover, lower wastage, a more flexible workforce, higher productivity or improved quality of products and services, instilling corporate culture or strategic goals and a range of non-economic benefits (see Billet & Cooper 1997, Dockery et al. 1997, Coopers & Lybrand 1994). A study of the hospitality, seafood and community services industries in Victoria surveyed managerial staff

about the outcomes from VET programs. With some exceptions, staff reported improved competency and productivity in a wide range of skills including, a decreased need for supervision, greater responsibility and self-sufficiency, greater initiative, increased confidence and good communication. A strong preference for specific training tailored to the needs of the industry and workplace was also expressed (OTFE 1999).

Chalkely (1991) found in a survey of 18 listed companies in Hong Kong, Malaysia, Indonesia, South Korea, Taiwan and Singapore, that skill shortages were a major issue for 60% of these companies. Initiatives taken by the companies in response included establishing training programs to address their specific needs. Some were substantial in terms of the cost and time involved. While two-thirds of the companies claimed that they were able to measure the results of the training, a uniform approach to this assessment did not exist, and appeared largely to rely on qualitative assessments by management on issues such as staff morale and problem-solving ability. In summary, 'no one has been able to prove statistically that companies which do undertake human resource development are ultimately more successful in the long term ... '. Despite the lack of quantitative data, however, the managers who participated in the survey were of little doubt that training had beneficial outcomes for their firms.

Comparing levels of wage growth with quantitative data on productivity in firms

As outlined above, a range of studies has examined the relationship between individual earnings and participation in various forms of education and training. In some studies, the assumed linkage between wages and productivity has been used to develop methods of comparing productivity increases with wages growth and correlating these changes with investments in training. That is, if productivity increases at a faster rate than wages, then a firm is receiving some proportion of the benefits from training and consequent productivity improvements (Brown 1989). A survey of 1901 firms in United States was used to obtain data on training and workers' productivity and wages. It was estimated the benefits of training were shared equally between firms and employees (Barron et al. 1989; see also Blundell et al. 1999). While this methodology has some characteristics in common with other surveys, it discusses the apportionment of benefits by comparing wage changes with estimated productivity changes.

OTFE (1998) outlines two further studies—Bishop (1994) and an unpublished paper by Groot (1997)—which compare wage data with productivity data in order to estimate returns from training. Both studies found that wages increased at a slower rate than productivity, suggesting that employees and firms both benefitted from productivity improvements from training. Holzer et al. (1993) cite a number of US studies that use micro-data for individuals to look at the incidence of on-the-job training for individuals, and their subsequent wage growth and productivity performance. They suggest that these studies show a sizable effect of training on both employee wages and productivity growth. A major reservation to this stream of research is that it is doubtful that the empirical methods adequately control for selection into training. Does the effect arise because it is the most promising employees that are afforded most on-the-job training? We know provision of training is associated with observable positive attributes of the employee, such as level of education, and this probably extends to unobservable attributes such as motivation.

Comparing quantitative data on productivity in an individual firm

Case studies are used to examine the effect of training in an individual firm. Two common approaches are to compare labour productivity in the one firm before and after the implementation of a training initiative, or to compare the performance of workers who have received training with those who have not. This type of approach can be used to determine

financial benefits or the payback period of training (Lee 1996). As with other approaches, it may be difficult to separate the effects of training from new work practices or changes in external conditions. For example, it is possible that the introduction of monitoring systems to determine the effectiveness of training programs caused behavioural changes that affected productivity.[1] Focussing upon quantitative data may also neglect issues of quality. For example, the effect of training programs on sales personnel by reference to sales data alone may neglect the issue of the quality of the relationship between sales personnel and customers. A short-term boost in sales data may neglect to reveal sales tactics which do not benefit a firm in the long term (Craven et al. 1993). Case study designs also face problems of selectivity that make it doubtful that findings can be extended to the population of firms at large. Different opinions are likely to be given depending upon the contact within the organisation. That the training or human resource manager is very positive about the benefits of training does necessarily mean the CEO is of similar mind. Further, many of the benefits of training are extremely hard to quantify.

These limitations aside, correlations between training and improved productivity are suggested from a range of studies examining sales and production data for individual firms. Such studies have been undertaken by academic researchers, but are also undertaken by firms themselves for the purpose of internal management, in which they are often referred to as 'cost–benefit analyses'. The measures of productivity vary widely, as do the gains attributed to training programs. In a car manufacturing plant, Lyau and Purcel (1995) used sales per worker and value-added per worker as measures of productivity and determined that a 10% increase in training expenditure per worker led to a 1% increase in value-added per worker. Russell et al. (1985) used sales data from retail stores to conclude that training had a positive effect. Hahne (1977) used sales data for trainees in a large US oil company and found that 84% of trainees improved their sales figures in the year after participation in a sales strategies training program.

Dockery et al. (1997) conducted a series of case study interviews for around 60 firms in which data on training costs, wages and productivity were estimated for each year of a standard apprenticeship and over the full four-year term. Employers or managers generally considered apprentices to be cost neutral or a net benefit to the firm over the four years. Yet in contrast to employers' perceptions and to human capital theory,[2] the calculations indicated that training apprentices typically cost the firm a substantial amount—on average around $25 000. It is not clear whether employers' perceptions on net costs are very wrong, or whether there are some significant benefits to training which the methodology fails to capture. Employers did appear, at least, to have a good sense of the way in which costs varied from a first to final years of an apprenticeship.

Billet and Cooper (1997, pp.18–21) cite several cost–benefit analyses and models for such evaluations. They note the complexity inherent in quantifying the returns to training measures. As a result, many cost–benefit analyses do not attempt to make quantitative estimates, but often rely upon a range of qualitative and quantitative measures to enable a subjective assessment of the success or otherwise of training measures. For example, one model suggested by several writers incorporates outcome measures at four different levels:

- participant satisfaction
- evidence of knowledge being acquired
- participant application of skill back on the job
- discernible improvements, in terms of reduced costs, improved quality

The range of 'indirect' and 'direct' outcome measures used in cost–benefit analyses reflects the uncertainty surrounding even the process by which training benefits accrue to the firm, let

[1] In one of the case studies discussed by Lee (1996), the results of the training were monitored by the setting of performance targets of a 15% improvement in the use of defined skills. However, the possible implications that these monitoring processes may have had on productivity are not discussed.

[2] As apprenticeships are general training, human capital theory postulates that it is the trainees that should pay for the training.

alone the existence of a positive payback. As a result, while some form of training evaluation is commonly conducted after training initiatives, very few firms conduct comprehensive cost–benefit analyses. Bartel (2000) reviews a number of internal evaluations carried out for US firms, but generally laments the lack of access to company databases that might aid researchers' efforts to isolate the effect of training. As Billet notes, 'Government appears more interested in a cost-benefit analysis than enterprises' (1997, pp.26–7).

Comparing quantitative data on productivity between firms with differing levels of training

Another approach to examining the effect of training and education is to examine firms or sets of firms that vary with respect to the amount of training and education undertaken by their staff, while controlling as far as possible for other factors which impact upon productivity. One means of control is to compare 'matched pairs' of firms, which are similar in terms of characteristics, such as location, size, quality, technology and employment practices. Studies to have taken this approach to analysing the effects of training on productivity include Daly et al. 1985; Steedman & Wagner 1987, 1989; Prais et al. 1989; Mason et al. 1992; Hashimoto 1994; Berg 1994.

In general terms these studies found increased levels of training and education to be positively correlated with greater productivity, improved workforce flexibility and potential improvements in product quality. The case-study approach allowed detailed examination of the specific institutions and programs of vocational training associated with each industry or firm. To this extent, the methodology reflects the usual strengths and weaknesses of a case study approach. The detailed appreciation of the factors contributing to the success of the higher-training firms comes at the expense of applicability of the findings to firms and industries subject to different institutions and constraints. However, taken together, the international comparisons provided by these studies suggest a significant payback to the institutions and practices found in those countries with stronger 'training cultures'.

A similar approach can be adopted using cross-sectional and panel data from a range of firms and examining correlations between training and productivity. This is the approach to be used in this study. Working with cross-sectional data and a Cobb–Douglas production function framework, Black and Lynch (1996) find no effect from the number of workers involved in training, but identify some productivity gains associated with formal (outside) training and computer training. With cross-section data only, they cannot use *changes* in productivity levels to control for heterogeneity (that is, unobserved characteristics of the firms that may effect the *levels* of variables). According to Bartel (2000, pp.508–10) the positive results identified for training in this study and for 'high performance work-practices' in another cross-sectional study (Huselid 1995) did not hold up once a further wave of data was incorporated to permit controls for heterogeneity, highlighting the importance of longitudinal data.

Holzer et al. (1993) examined a panel of US manufacturing firms that had applied for a training subsidy. Their results suggest that firms who received the subsidy increased training and also recorded a drop in the 'scrap rate' (wastage rate) of workers, interpreted as a training-induced improvement in productivity. Whether this can be taken to imply that, in the absence of the subsidy, increased training would improve profitability depends on whether the gains outweigh the full training costs. Bartel (1994) notes that the relationship between training and productivity may be obscured if low-performing firms are more likely to implement training programs in an effort to catch up to their competitors, or if high-performing firms are more likely to be able to finance training programs. She uses data matched for US manufacturing firms in 1983 and 1986 to test these relationships. In her estimations, low-productivity firms in 1983 are found to be both more likely to implement training programs and to have higher increases in value added per employee. Moreover, the increase in value added attributed to training programs is over and above any 'convergence to the mean' effect. Using data from the Australian Workplace Industrial Relations Survey

(AWIRS), Loundes (1999) also finds evidence that formal training for employees was a contributing factor in higher rates of productivity growth in workplaces.

Comparing quantitative data on productivity between regions or industries with differing levels of training

At an aggregate level, large-scale surveys provide a mechanism for examining the possible correlation of different systems of vocational education and training with profitability or competitiveness across a range of firms and industries. A major UK study examined a range of features of training institutions in Germany, France, Japan, Singapore and the United States (see Felstead 1995). While the report aimed at providing comparative data on VET achievements in different countries, the impetus for the study arose from the perception that economic success which was once attributed to cheap labour, is increasingly attributable to effective education and training which is designed to upgrade the skills of a country's workforce. Prais (1995) has also used comparative international studies to link apprenticeship training systems with international competitiveness.

Innovative human resource management practices

Companies' human resource (HR) practices encompass more than the amount and type of training provided; however, there is a tendency to equate 'good' HR policy with a higher training effort. Thus there is a literature dealing with the effectiveness of different HR practices for firm performance that, although not directly related to the effect of training *per se*, deserves mention here. Huselid (1995) notes an emerging 'conventional wisdom' that HR practices, including recruitment/selection, incentive payments, employee involvement and training, can be a source of competitive advantages if appropriately aligned with a wider strategic plan. He adds the important caveats that it is among HR professionals that this wisdom is emerging, and that it is grounded largely in theoretical rather than empirical considerations (1995, p.635).

Reviews of studies in this area, relating almost entirely to US firms, can be found in Huselid (1995), Huselid and Becker (1996) and Ichniowski et al. (1996), while Will's (1999) discussion incorporates some of the Australian-based contributions. The research continues to face significant challenges. The measurement difficulties associated with innovative or 'high performance' HR practices are far more onerous than in the case of training. What constitutes innovative practices? Inevitably, measures need to be constructed through survey instruments, which will have varying degrees of validity. Through management questionnaire responses Huselid (1995) attempts to further develop measures of whether HR policies 'fit' with other company strategies, recognizing that what is appropriate for a firm in one internal or external environment may not be appropriate for different environments. In a cross-section sample of around 1000 firms, he finds only modest empirical evidence that 'fit' offers any greater explanatory power for firm performance than simply the adoption or otherwise of high-performance practices, despite the 'compelling theoretical argument that better internal and external fit will increase firm performance'.

The problems noted above of potential bias in estimating the impact of training also apply here, such as the presence of unobserved factors affecting both a firm's performance and the likelihood of it implementing innovative practices, and potential endogeneity in which it is the firm's level of performance itself that directly affects its HR practices. One can make a case either way that low-performing or high-performing firms, when viewed at a particular point of time, may be more likely embrace innovative practices. By re-estimating results from cross-sectional studies with panel sub-samples, Huselid and Becker (1996) question whether panel data can overcome these limitations. Although they allow potential controls for bias, panel data also introduce greater measurement error, for example through different respondents. They still conclude, however, that the use of high-performance HR practices offers sizable gains in worker productivity. In a recent Australian study, Will's (1999) analysis of AWIRS, is

also constrained to cross-sectional methods and by the availability of only qualitative responses regarding changes in productivity. She obtains ambiguous results regarding the effect of intensive versus moderate usage of a range of formal HR practices on labour productivity and wages.

Ichniowski et al. (1996) concentrate on the impact of 'innovative work practices' interpreted to mean the general gamut of practices that increase employee autonomy, teamwork and profit-sharing. They cite a number of case studies which purport to have found evidence of large performance gains as a result of the implementation of such innovative practices. They conclude that innovative work practices can have a large impact, but that there are no single 'magic bullets'. Strategies need to use 'systems of related work practices designed to enhance worker participation and flexibility in the design of work and decentralization of managerial tasks and responsibilities' (Ichniowski et al. 1996, p.322). One lesson of this literature is that training perhaps also needs to be considered in a wider strategic context than simply the incidence of training, expenditure or duration, although few Australian data sets would permit such a refinement.

Current state of research

The current state of research reflects many of the complexities associated with estimating the returns to firms of investment in education and training. Blundell et al. (1999) argue that a consensus has formed on the existence of private returns to education and training, but the impact of training on firm performance remains uncertain due to data deficiencies and methodological complexities. Barron et al. (1997) demonstrate, for example, that measures of training differ markedly between different surveys, and in particular, employers tend to report higher incidences of training than do workers.[1] However, from the range of studies examined in this review, it is possible to draw two significant conclusions:

- Across the range of approaches used to examine the returns to firms from training, most studies have found that firms do benefit from having a relatively well-educated and skilled workforce and from undertaking specific training programs.
- There are significant difficulties with accurately estimating returns to training. However, confidence in the findings of positive outcomes from training is enhanced by the range of methodologies and studies that have consistently found benefits.

Of course, because of selection issues, evidence of net benefits for firms that *do train* is not sufficient to conclude that benefits would also exist for other firms. There remains much to be explored in the way of development of a more comprehensive theoretical framework, and in relation to the mechanisms through which the benefits from investment in training accrue and the relationships between training outcomes and other variables such as unionisation, employee relations and market competitiveness, as well as through empirical interrogation of existing data sets.

[1] This may have led to a significant underestimate of the true impact of training in many studies. See Barron et al. 1997, pp.523–6.

The BLS and training data

The confidentialised unit record file (CURF) from the Business Longitudinal Survey covers Australian firms with 200 or less employees. The population frame for the sample was the ABS business register with a number of exclusions; namely, non-employing business, government businesses, and businesses from selected industry categories. The CURF comprised records for an initial sample of 8376 firms interviewed at the end of 1994–95[1]. A sub-sample of 4700 firms was selected from the first year to continue on the panel. At the end of each of the (financial) years of the survey, an additional sample of new businesses was added, drawn from those newly appearing in the ABS business register.

Table 1: BLS sample by year and panel status

	1994–95	1995–96	1996–97	1997–98
Continuing firms	8376	4700	4657	4661
New firms	0	327	409	463
Total sample	8376	5027	5066	5124
Ceased operating	1	488	371	406
Business attrition rate		5.8%	7.4%	8.0%

There is a total of 3867 firms for which responses are available in all four waves of the survey. From the firms that were selected to continue from the first to second years, the actual attrition rate, attributable to firms ceasing to operate, is quite modest (table 1).

The major data items relating to training and the years in which they were collected are listed in table 2. As can be seen, there is an unfortunate concentration of the collection of training data in the final year. This limits the scope for a detailed analysis of training developments in response to other factors, and also means that we have to make some assumptions regarding training practices for the earlier years based on the final year data which may not necessarily hold true in all cases. However, the data are rich enough to develop summary variables, such as whether a firm is a high, medium or low trainer, which can be used with some confidence. There are also good indicators of whether there was a significant increase or decrease in certain types of training for the middle two years, plus retrospective data for the three years up to and including 1994–95. The expenditure on staff training related to innovations in products or processes is also collected in all years for the relevant firms.

[1] Not all the records for firms in the BLS have been included in the CURF. For example, firms with more than 200 employees are excluded. For convenience, however, we refer to the BLS sample as meaning those available on the CURF.

Table 2: Summary of training variables available in the BLS CURF

	1994–95	1995–96	1996–97	1997–98
Have there been major changes during the last 3 years (increase/decrease) in:				
technical training	✓			
management training	✓			
Have there been major changes during last financial year (increase/decrease) in:				
management training		✓	✓	
on-the-job training		✓	✓	
other training		✓	✓	
Did the business have any links with other business during the financial year with the purpose of increasing training capability (manuf. only)?				✓
No. of managerial staff with tertiary qualifications in business m'ment, commerce or administration	✓			
No. of managerial staff who undertook training in business m'ment during financial year	✓			
Did the number of people being trained by the business increase/decrease in previous 12 months?				✓
Expenditure on development of new or changed products or processes: training of staff	✓	✓	✓	✓
During the financial year, the percentage of employees that participated in:				
structured training courses				✓
on-the-job training				✓
seminars, workshops, conferences etc.				✓
job rotations, exchanges etc.				✓
During the financial year, the percentage of employees that received:				
management training				✓
professional training				✓
training for computer specialists				✓
trade/apprenticeship/traineeship training				✓
health and safety training				✓
other training				✓
Did the business use any of the following providers to train its employees during the financial year:				
employees/owners providing on-the-job training				✓
employees/owners providing structured training				✓
professional associations				✓
industry associations				✓
equipment manufacturer/supplier				✓
private training consultant				✓
TAFE				✓
university				✓
other				✓

Training by Australian firms: A descriptive overview

Level of training: 1997–98

Initially we provide a descriptive summary of the static measures of the level of training. As shown above, the relevant variables here were mostly collected in the 1997–98 wave only. The main variables indicating the level of training are:

- type of training—proportion of employees who participated in four different types of training—structured training courses, on-the-job training, participation in seminars, workshops, conferences etc. and participation in job rotations, exchanges etc.
- field of training—proportion of employees who participated in management training, professional training, training for computer specialists, trade training, occupational health and safety and other forms of training
- training providers—whether or not the firm had used a range of training providers

Type of training

Distributions of the proportion of employees participating in each of the four types of training are tabulated in tables 3a to 3d. The most important of these four categories can be considered to be structured training and on-the-job training. While no precise definition is available, these categories can be taken to broadly equate to formal and informal training. On-the-job training was by far the most common form of training, with 68.1% of all firms indicating that some employees received this form of training. If we use the midpoints of the response categories to calculate the average proportion of employees undertaking training, we find that, for the average firm, 30.7% of employees received on-the-job training, 13.4% participated in structured training, 12.1% in seminars, workshops, conferences and 9.4% in job rotation, exchanges etc.

The positive correspondence between firm size and training intensity is evident for all four forms of training. For example, no employees received structured training in 1997–98 in 86% of firms with 1 to 4 employees. For firms with 50 or more employees, this number falls to 16%. Statistically, such a result may occur even if large firms provide the same level of training per employee. Assume, for example, half of all employees in the labour force participate in structured training, and the incidence is distributed randomly across the labour force irrespective of firm size. We would still observe a far fewer proportion of large firms in which no employees received training than would be the case for small firms. However, the means show us that the intensity of training is also higher in large firms. An average of 5.5% of employees received training in firms with 1 to 4 employees, compared to 24.6% in firms with 50 or more employees. For on-the-job training, the average rises from 15.1% for small firms to 40.8% for large firms. Increases in training intensity with size are also apparent for participation in 'seminars, workshops etc' and participation in 'job rotation, exchanges etc'.

The cultural and recreational services industry and the construction industry consistently appear as low trainers along with, to a lesser extent, the accommodation, cafes and restaurants industry. As to which industries are 'high' trainers, the rankings vary considerably depending upon the measure used. In terms of policy focus, at least, structured training is considered the most important form. Firms from the finance and insurance, property and business services and mining industries had the highest average proportion of employees participating in this form of training. For on-the-job training, differences between industry sectors seem small, with the means for nine of the 11 industry categories ranging from 28.6% to 33.6% (the average for construction firms was 25% of employees participating in on-the-job training and for cultural and recreational services 17.2%). Finance and insurance and property and business services also made the most extensive use of seminars, workshops and conferences and manufacturing the most extensive use of 'job rotations, exchanges etc'. Much of the inter-

industry variation is likely to be attributable to the differences in the firm size between industries.

Table 3a: Proportion of employees who participated in structured training during 1997–98, by industry and firm size

	None	1 to 25%	26 to 50%	51 to 75%	76 to 100%	Total	Mean	n
Industry								
Mining	49.2	27.9	6.6	6.6	9.8	100	18.6	61
Manufacturing	52.1	37.0	5.8	2.1	3.2	100	10.8	1510
Construction	65.1	21.8	7.0	2.8	3.2	100	9.9	284
Wholesale	46.7	35.0	10.0	4.0	4.3	100	14.4	672
Retail	54.2	26.9	9.9	4.2	4.8	100	13.9	476
Accom, café & rest.	62.0	22.2	9.4	1.8	4.7	100	11.5	171
Transport & storage	60.5	24.9	3.4	4.5	6.8	100	13.1	177
Finance & insurance	51.8	19.7	11.9	7.8	8.8	100	19.5	193
Prop & bus. svcs	52.0	22.3	9.4	6.4	9.7	100	18.9	636
Cultural & rec. svcs	68.9	21.7	3.8	3.8	1.9	100	8.1	106
Personal & other svcs	59.0	22.9	8.6	2.9	6.7	100	13.7	105
Total	**53.6**	**29.8**	**7.8**	**3.7**	**5.1**	**100**	**13.4**	**4391**
No. of employees								
1 to 4	85.8	6.5	3.8	1.0	3.0	100	5.5	1223
5 to 9	66.9	20.0	6.5	2.3	4.4	100	10.2	755
10 to 19	51.8	33.7	5.9	2.9	5.6	100	13.2	679
20 to 49	33.9	46.2	10.1	3.5	6.3	100	17.2	943
50 or more	15.9	52.3	14.3	10.4	7.1	100	24.6	791
Total	**53.6**	**29.8**	**7.8**	**3.7**	**5.1**	**100**	**13.4**	**4391**

Table 3b: Proportion of employees who participated in on-the-job training during 1997–98, by industry and firm size

	None	1 to 25%	26 to 50%	51 to 75%	76 to 100%	Total	Mean	n
Industry								
Mining	42.6	13.1	16.4	8.2	19.7	100	30.1	61
Manufacturing	24.2	31.8	17.3	10.9	15.9	100	31.1	1511
Construction	44.7	21.5	10.9	7.0	15.8	100	25.0	284
Wholesale	25.3	27.2	16.2	13.1	18.2	100	33.6	672
Retail	32.4	23.1	12.0	9.7	22.9	100	33.5	476
Accom, café & rest.	41.5	13.5	12.9	10.5	21.6	100	32.0	171
Transport & storage	40.1	20.9	10.2	9.6	19.2	100	29.2	177
Finance & insurance	42.0	19.7	10.4	8.8	19.2	100	28.6	193
Prop & bus. svcs	39.2	18.5	13.8	10.4	18.1	100	29.8	637
Cultural & rec. svcs	49.1	29.2	8.5	4.7	8.5	100	17.2	106
Personal & other svcs	33.0	22.6	13.2	7.5	23.6	100	33.1	106
Total	**31.9**	**25.4**	**14.5**	**10.3**	**17.9**	**100**	**30.7**	**4394**
No. of employees								
1 to 4	70.1	9.9	6.5	1.6	11.9	100	15.1	1223
5 to 9	34.4	22.5	14.7	8.5	20.0	100	31.1	756
10 to 19	18.9	32.5	14.2	12.6	21.7	100	36.3	681
20 to 49	11.8	34.6	18.8	14.8	20.0	100	38.2	943
50 or more	5.7	34.9	22.0	18.2	19.2	100	40.8	791
Total	**31.9**	**25.4**	**14.5**	**10.3**	**17.9**	**100**	**30.7**	**4394**

Table 3c: Proportion of employees who participated in seminars, workshops, conferences etc. during 1997–98, by industry and firm size

	None	1 to 25%	26 to 50%	51 to 75%	76 to 100%	Total	Mean	n
Industry								
Mining	52.5	27.9	13.1	3.3	3.3	100	13.3	61
Manufacturing	53.4	38.8	4.4	1.8	1.6	100	9.0	1510
Construction	71.1	20.8	4.6	1.4	2.1	100	7.0	284
Wholesale	44.8	40.3	9.6	2.8	2.5	100	12.6	670
Retail	53.4	33.0	7.6	2.9	3.2	100	11.6	476
Accom, café & rest.	64.9	26.3	6.4	0.6	1.8	100	7.6	171
Transport & storage	61.4	23.9	5.1	2.8	6.8	100	12.6	176
Finance & insurance	42.0	25.4	14.0	9.3	9.3	100	22.4	193
Prop & bus. svcs	47.0	25.0	13.7	7.4	6.9	100	18.9	636
Cultural & rec. svcs	62.3	29.2	2.8	1.9	3.8	100	9.2	106
Personal & other svcs	54.7	24.5	8.5	4.7	7.5	100	15.8	106
Total	**52.8**	**32.8**	**7.6**	**3.3**	**3.5**	**100**	**12.1**	**4389**
No. of employees								
1 to 4	83.1	6.4	4.6	1.0	5.0	100	7.5	1222
5 to 9	65.9	20.8	7.4	3.3	2.5	100	9.7	754
10 to 19	51.8	34.0	6.2	5.0	3.1	100	12.4	680
20 to 49	36.2	48.5	8.7	3.3	3.3	100	14.3	942
50 or more	14.3	65.5	12.3	5.3	2.7	100	18.4	791
Total	**52.8**	**32.8**	**7.6**	**3.3**	**3.5**	**100**	**12.1**	**4389**

Table 3d: Proportion of employees who participated in job rotation, exchanges etc. during 1997–98, by industry and firm size

	None	1 to 25%	26 to 50%	51 to 75%	76 to 100%	Total	Mean (%)	n
Industry								
Mining	73.3	15.0	5.0	6.7	0.0	100	7.9	60
Manufacturing	55.6	26.6	9.1	5.5	3.2	100	13.0	1510
Construction	79.9	12.0	3.5	3.2	1.4	100	6.0	284
Wholesale	63.3	27.3	6.3	1.6	1.5	100	8.1	671
Retail	65.8	22.5	4.2	4.0	3.6	100	10.0	476
Accom, café & rest	76.6	13.5	7.6	1.2	1.2	100	6.3	171
Transport & storage	71.0	19.3	6.3	2.3	1.1	100	7.2	176
Finance & insurance	70.8	17.7	5.7	3.6	2.1	100	8.5	192
Prop & bus. svcs	72.5	19.2	6.4	1.6	0.3	100	6.1	636
Cultural & rec svcs	77.4	16.0	4.7	0.9	0.9	100	5.2	106
Personal & oth svcs	76.2	8.6	7.6	4.8	2.9	100	9.4	105
Total	**65.3**	**22.2**	**6.9**	**3.5**	**2.1**	**100**	**9.4**	**4387**
No. of employees								
1 to 4	94.6	1.9	1.3	1.0	1.2	100	2.4	1223
5 to 9	76.4	9.5	7.4	3.2	3.4	100	9.0	754
10 to 19	63.1	21.2	8.4	4.9	2.4	100	10.9	678
20 to 49	46.5	36.6	9.8	4.9	2.2	100	13.2	941
50 or more	33.4	49.3	10.2	5.1	2.0	100	14.9	791
Total	**65.3**	**22.2**	**6.9**	**3.5**	**2.1**	**100**	**9.4**	**4387**

In their study matching employer and employee responses by establishment, Barron et al. (1997) find that employers report significantly higher levels of training than do workers. However, the estimates of the incidence of training from the BLS seem lower than those reported by wage and salary earners in the ABS Survey of Education and Training Experience. In the 1997 ABS survey, 30% of workers reported participating in in-house training courses and 11% in employer-supported external training courses in the previous 12 months. Definitional differences aside, this is high relative to the mean above of 13.4% of employees participating in structured training. The ABS survey reports that around 70% of wages and salary earners participated in on-the-job training, also much higher than our estimate derived from the BLS data. Some of this inconsistency will be due to the ABS survey covering employees of large firms, while the BLS is restricted to firms with less than 200 employees.

Field of training

The proportion of employees receiving training is also recorded for different fields of training. Respondents could choose from the same five categories as in the tables above, and the midpoints are again used to generate a mean value across firms. In this case it is clear that the level of training will be strongly related to employment structure within the firm—firms with no professionals or tradespersons will not undertake training in these fields. Typically around 4 to 6% of employees received management training; professional training; training for computer specialists; and trade, apprenticeship or traineeship training. Health and safety training was more common, with an estimated business average of 8.2% of employees receiving training in this area. More common still was training in the miscellaneous 'other' category. The strong correlation between firm size and the proportion of employees receiving training holds across each of the fields of training.

Table 4: Mean percentage of employees receiving training during 1997–98, by training field and firm size

No. of employees	Field of training					
	Management	Professional	Computer specialists	Trade, app. & trainees	Health and safety	Other
1 to 4	2.4	2.6	2.4	2.2	3.0	5.4
5 to 9	4.2	3.7	4.6	3.1	4.7	9.8
10 to 19	4.9	4.9	5.6	4.0	6.6	11.6
20 to 49	6.4	5.2	7.5	5.3	11.2	14.9
50 or more	10.3	8.9	11.5	6.2	17.2	17.0
All firms	5.4	4.9	6.0	4.0	8.2	11.2
N (responses)	4381	4382	4382	4381	4379	4379

Use of training providers

In all industries the training provider used by the most businesses was simply their own internal employees or owners for delivering on-the-job training. Around 50% of businesses indicated having used this means of training provision in 1997–98. Twenty-three per cent of firms indicated using internal personnel for structured training as well. In terms of external providers, one-fifth to one-quarter of businesses indicated they had used each of industry associations, professional associations, equipment manufacturers or suppliers and TAFE. The figure for TAFE of 21% indicates a surprisingly low penetration rate in relation to other external providers. Private training consultants were used by 16% of businesses and just 8% indicated that they had used the university sector as a training provider during the year.

Table 5: Proportion of firms using various training providers in 1997–98, by industry and firm size

	Employees or owners		Professional associations (%)	Industry associations (%)	Equipment manufacturers or suppliers (%)	Private training consultant (%)	TAFE (%)	University (%)	Other provider (%)
	On-the-job training (%)	Structured training (%)							
Industry									
Mining	52	23	35	30	35	27	14	17	2
Manufacturing	59	22	21	25	28	17	28	8	3
Construction	45	14	12	18	16	8	25	4	3
Wholesale	60	27	28	27	35	21	19	8	2
Retail	57	26	17	25	28	11	18	3	4
Accom, café & rest.	44	15	16	20	15	9	21	3	2
Transport & storage	49	23	18	26	15	11	15	4	3
Finance & insurance	43	22	34	31	16	18	8	17	2
Prop & bus. svcs	48	27	32	26	20	19	11	12	4
Cultural & rec. svcs	38	19	19	11	13	13	9	5	2
Personal & other svcs	58	19	18	27	22	12	26	2	2
Total	**54**	**23**	**23**	**25**	**25**	**16**	**21**	**8**	**3**
No. of employees									
1 to 4	24	6	7	7	6	3	5	1	2
5 to 9	55	15	12	14	16	9	14	3	3
10 to 19	66	23	20	26	29	14	20	5	3
20 to 49	68	32	33	36	36	22	30	9	3
50 or more	73	47	50	50	47	40	40	22	3
All firms	**54**	**23**	**23**	**25**	**25**	**16**	**21**	**8**	**3**

There is the omnipresent relationship between number of employees and the use of each type of provider, but also considerable variation between industry sectors. The mining industry stands out as a heavy user of all the external training providers listed with the exception of TAFE. TAFE's penetration is greatest in the manufacturing, construction and personal and other services, presumably reflecting its position as the main provider of technical training for the major trade areas of building, engineering and fabrication and hairdressing. The construction industry is a low user of all other forms of external providers apart from TAFE. The finance and insurance sector and the property and business services sector make considerable use of professional and industry associations for training provision. Retail, accommodation, cafes and restaurants, transport and storage and cultural and recreational services all make relatively low use of external providers, consistent with previous evidence of low levels of training in these industries.

Changes in training practices

At the end of 1994–95, each respondent in the BLS was asked whether or not there had been any major increases or decreases in the level of technical training and management training over the past three years; that is, the three years leading up to and including the first year of the survey. The responses are summarised in table 6. It can be seen that, overall, far more firms indicated that there had been an increase in training as a major change in the business over the past three years than indicated a decrease. However, the modal response was still that no change had occurred. The 'not applicable' categories make the interpretation of this data more awkward.

Table 6: Whether a major change in training in three years to 1994–95, by firm size

	Per cent of applicable responses			Number of applicable responses	Number non-applicable[1]
	Decrease	No change	Increase		
Technical training					
1 to 4	1.9	72.6	25.6	1286	1127
5 to 9	0.6	66.0	33.4	1090	441
10 to 19	0.4	61.2	38.4	922	181
20 to 49	0.3	53.5	46.2	1453	167
50 or more	0.4	48.7	51.0	1097	100
Total	**0.8**	**60.3**	**38.9**	**5848**	**2016**
Management training					
1 to 4	1.6	80.6	17.8	1283	1130
5 to 9	0.6	76.2	23.1	1077	452
10 to 19	0.5	73.2	26.3	925	168
20 to 49	0.3	61.7	38.0	1489	127
50 or more	0.4	54.0	45.5	1142	59
Total	**0.7**	**68.7**	**30.5**	**5916**	**1936**

Note: 1. Includes firms which have ceased to operate, yet to enter the survey sample, and those responding 'not applicable'.

In the following two years, 1995–96 and 1996–97, businesses were asked whether there had been any major change in that year; this time in relation to management training, on-the-job training and 'other training' (table 7). We do not report the results for 'other training', but note they are very similar in magnitude and pattern to those for management and on-the-job training. As would be expected, more businesses report no major changes for the single years of 1995–96 and 1996–97 than for the previous three-year period. It is interesting to note that large firms appear not only to provide more training on all measures, but were also more likely to report a major increase in training for each of these periods. Taken literally, this is not a feasible long-run situation—large firms cannot continuously increase their level of training

relative to small firms. Yet it is also dubious that the survey took place during a period in which large firms were unusually active in increasing training while small firms were not. Rather than an absolute increase in the level of training in terms of expenditure or the number of employees receiving training, we expect that affirmative responses to 'major change—increase' also relate to efforts to improve training or the implementation of training in response to new processes or strategic goals, many of which replaced existing training practices. Such a process of continual improvement need not imply a continuous increase in the level of training, and we take the results to imply that larger firms, on average, more regularly review and overhaul their training practices. The same explanation would account for the far larger proportion of firms that record a major increase in training as opposed to a major decrease in training.

Table 7: Whether a major change in training occurred in the last financial year, by firm size

1995–96

No. of employees	Per cent of applicable responses			Number of applicable responses	Number non-applicable[1]
	Decrease	No change	Increase		
Management training					
1 to 4	0.3	86.6	13.1	620	753
5 to 9	0.2	81.7	18.2	567	330
10 to 19	0.2	79.3	20.5	589	168
20 to 49	0.3	71.4	28.2	931	162
50 or more	0.1	69.7	30.2	776	131
Total	**0.2**	**76.7**	**23.0**	**3483**	**1544**
On-the-job training					
1 to 4	0.3	79.5	20.2	718	655
5 to 9	0.1	73.8	26.1	687	210
10 to 19	0.6	66.8	32.6	648	109
20 to 49	0.4	62.3	37.3	969	124
50 or more	0.1	61.8	38.1	790	117
Total	**0.3**	**68.3**	**31.4**	**3812**	**1215**

1996–97

No. of employees	Per cent of applicable responses			Number of applicable responses	Number non-applicable[1]
	Decrease	No change	Increase		
Management training					
1 to 4	1.1	91.3	7.6	629	755
5 to 9	0.5	87.0	12.5	593	312
10 to 19	0.5	83.6	15.9	605	149
20 to 49	0.8	80.0	19.3	929	189
50 or more	0.1	75.1	24.8	763	142
Total	**0.6**	**82.8**	**16.7**	**3519**	**1547**
On-the-job training					
1 to 4	1.1	87.1	11.8	713	671
5 to 9	0.4	79.3	20.3	686	219
10 to 19	0.8	74.3	25.0	645	109
20 to 49	0.7	69.9	29.3	958	160
50 or more	0.3	69.0	30.8	773	132
Total	**0.7**	**75.4**	**23.9**	**3775**	**1291**

Note: 1. Includes firms which have ceased to operate, yet to enter the survey sample and those responding 'not applicable'.

A higher proportion of firms recorded an increase in both management and on-the-job training in 1995–96 than in 1996–97. The final year's survey asked more specifically if the actual *number* of people being trained by the business had increased or decreased in the last 12 months. Of those who responded, one-quarter indicated that they did not provide training in any case, but this was as high as 55% for firms with 1 to 4 employees. Even though the question now directly relates to the number of people being trained, the number indicating an increase far outweighs those indicating a decrease. Only 2.8% of firms admitted to a decrease in the number of people being trained, compared with 21.8% claiming an increase. Again, the increases in training are reported far more frequently in larger firms.

Table 8: Whether the number of persons trained by the business changed in 1997–98, by number of employees

No. of employees	No training provided (%)	Decreased (%)	Stayed the same (%)	Increased (%)	Applicable responses
1 to 4	55.5	2.6	35.7	6.1	1257
5 to 9	25.1	3.4	53.2	18.3	786
10 to 19	13.7	3.1	58.9	24.3	703
20 to 49	7.9	2.0	60.5	29.6	959
50 or more	3.7	3.0	55.2	38.1	805
Total	**24.3**	**2.8**	**51.1**	**21.8**	**4510**

Probably of more interest than the change in these aggregates over the survey years is the question of whether it is the same businesses recording changes, or different businesses each year. That is, are there specific firms that are continually implementing changes, or are such changes distributed relatively randomly across firms and time. To test this we recode the responses as -1 for a decrease in training, 0 for no change and +1 for an increase, and calculate the correlation coefficients for each of the variables. For the question of whether the number of employees receiving training had increased in 1997–98, the response of 'no training provided' is taken as a zero for no change.

Table 9: Correlation coefficients between changes in training variables: whether there had been an increase, decrease or no change in each type of training

	Mgt 95	Tec 95	Mgt 96	Job 96	Oth 96	Mgt 97	Job 97	Oth 97	Num 98
Mgt'95	1.00								
Tec'95	0.59	1.00							
Mgt'96	0.23	0.20	1.00						
Job'96	0.19	0.22	0.56	1.00					
Oth'96	0.21	0.21	0.52	0.61	1.00				
Mgt'97	0.18	0.18	0.32	0.28	0.26	1.00			
Job'97	0.12	0.17	0.25	0.35	0.27	0.59	1.00		
Oth'97	0.10	0.13	0.25	0.28	0.30	0.55	0.62	1.00	
Num'98	0.09	0.13	0.12	0.16	0.13	0.16	0.19	0.17	1.00

Notes: Mgt = management training ; Tec = technical training ; Job = on-the-job training; Oth = other training; Num = no. of employees receiving training; All coefficients significantly different from zero at the 1% level.

Within each wave of the survey there is a high correlation between the responses for different types of training. In the 1995 survey, for example, there is a strong positive correlation (coefficient of 0.59) between a business reporting a major change (increase) in management training in the past three years and that business reporting an increase in technical training in the past three years. Similarly, strong positive correlations are found between changes to management training, on-the-job training and other training for the years of 1996 and 1997. The correlations from one year to the next are much smaller, but all of the coefficients are positive and highly significant in statistical terms. The magnitudes also decrease over time, as would be expected. We can conclude from this that changes to training within businesses have a tendency to be implemented across the different types of training simultaneously. There is a much smaller but still significant relationship whereby firms implementing training

changes are likely to undergo further similar changes in the following years. This may reflect either the fact that the implementation of changes occurs over a period of a number of years, or that it is a particular characteristic of certain firms to regularly implement such changes.

Determinants of training practices

Background

What determines whether a business is a high trainer or a low trainer? A number of studies has previously examined this issue, and it is of particular importance to policy-makers given the concerted effort by government to convince or entice businesses to lift their training effort. We have seen above, and other studies universally show, that training effort is strongly related to firm size, however measured. This relationship has been analysed extensively by Baker and Wooden (1995). In part, it has been shown to be due to a concentration of lower-skilled and part-time or casual jobs in small firms, and it is also the case that lower-skilled employees receive less training. However, economies of scale are the most common explanation. Baker and Wooden also find that, with respect to formal training, it is the incidence rather than amount of training that drives the lower training levels in small firms. Fewer workers receive formal training, but when they do, the amount of training received is as great as in large firms (1995, p.63). Other factors identified in previous studies as being important determinants of the amount of training provided include, competitive pressures, industry and sector, the proportion of employees who are casual or part-time (and by association the proportion who are female), staff turnover, the level of management training, degree of unionisation and other industrial relations features.

Holzer et al. (1993) show that public training subsidies can be effective in raising the amount of training provided for recipient firms. The effect of factors can vary between types of training, such as formal versus informal or structured versus unstructured training (see, for example, Frazis et al. 1998; ABS 1997; Smith et al. 1995; Dockery 1993).[5] Based on AWIRS data, Dockery (1993) finds training to be higher in firms with internal labour market structures, consistent with the finding by Frazis et al. (1998) for the US of a positive relationship between training provision and longer-term employee relationships. Baker and Wooden (1995, pp.8–12) provide a review of earlier Australian studies and a discussion of the policy context.

In this section we investigate the BLS data to identify characteristics associated with high-training firms and with changes in training. Initially, levels of training, as measured by the proportion of employees receiving training, are modelled. In relation to changes in training, so few firms indicated that they had experienced a decrease in training, we look specifically at the factors associated with an increase in training.

Who are high trainers?

The analysis concentrates on structured and on-the-job training as the two most important forms of training provided by businesses. Although it is not necessarily the case, structured training is generally considered to be of higher quality, or to represent a greater investment in training than on-the-job training. As the data relating to these forms of training take on polychotomous, discrete values (see footnote to table A1), an appropriate analysis technique is to use the ordered probit model. The results of the models estimated are provided in appendix table A1.

[5] There is a much larger literature concentrating on the effects of characteristics of individual workers on the amount of training they receive. Blundell et al. (1999) provide a good overview.

The first two models are for structured training, with the second including a variable for the proportion of employees receiving the other form of training (on-the-job training). The same format is followed for the models estimating the proportion of employees receiving on-the-job training (models 3 and 4). The data set allows a very large number of potential variables for inclusion as regressors. Those that were perceived as likely to have an association or influence with training effort have been tested. We have also limited the explanatory variables to those collected in the same year as the dependent variables (1997–98) rather than all possible historic variables, as this avoids missing values for new businesses entering the survey or otherwise not responding in previous years. The longitudinal data are utilised in modelling changes in training effort below. Variables achieving very low levels of significance were dropped.

It must be kept in mind in the following discussion that a significant relationship between variables does not imply a causal relationship, only an association. For example, the association between research and development variables and training effort is likely to reflect a particular culture influencing both research and development (R & D) and training effort, rather than R&D activities 'causing' more training to be undertaken. It is also the case that variables are not available in the BLS for a number of factors known to be important in influencing training decisions, and hence the models suffer from the usual problems associated with omitted variables. Some of these factors include the intensity of competition faced by the firm, whether the firm is part of a larger organisation or network, the education and skill levels of the employees and whether the firm operates a relatively open as opposed to 'internal' labour market structure.

The highly significant correlation between the provision of structured and on-the-job training (models 2 and 4) suggests the two are not generally used as substitutes, but rather as complements. Firms with strong training cultures are likely to provide both forms of training.

Firm size and age

From the preceding discussion, the most obvious candidate for inclusion among the explanatory variables is the number of employees in the businesses. The coefficient on this variable indeed has the expected positive sign and is highly significant. Here we can be more confident that causal forces are at work. A squared term is also highly significant and negative, indicating that training increases with firm size, but at a decreasing rate.

The age of the business is positively associated with the proportion of employees receiving structured training in model 2, but negatively associated with on-the-job training. This would seem to reflect that new businesses initially adopt on-the-job training methods, and later develop structured training practices as they mature. This result may also reflect a selectivity effect, as it is the more successful businesses that will age (survive) while less successful business will fail.

Employee characteristics

Higher proportions of employees who are part-time are associated with a lower incidence of both structured and on-the-job training. Casual employment, on the other hand, appears to induce less structured training but more on-the-job training. If these variables are excluded, the coefficient on the percentage of workers who are female is negative and highly significant, suggesting the part-time or casual nature of employment is a main reason for lower training in female-dominated sectors.

In the human capital model, training is treated as an investment, the benefits of which are recouped through higher post-training productivity. Hence a negative relationship between labour turnover and training investment is predicted, as labour turnover limits the time horizon for the firm to recoup the investment in training. However, since new employees often require immediate training, such as induction training and guidance by experienced workers, there is also an opposing effect in which greater turnover will result in more training

being observed. For on-the-job training it appears this latter effect dominates. No significant effect of labour turnover is found in the case of structured training.

Industry effects

The industry effects are large and significant in the case of structured training. Ideally we would like to render the industry effects insignificant by the inclusion of other variables that explain what it is that differs between industries to cause them to offer differing levels of training. Either we have been far more successful in explaining the inter-industry variation in the degree of on-the-job training; or, the industry-specific effects for structured training are much stronger. The latter situation is most likely. The industry variables are jointly significant in the case of structured training, but not in the two models for on-the-job training.

Compared to the excluded category of manufacturing, businesses in the industries of construction, wholesale, retail, finance and insurance, property and business services and personal and other services all record a higher level of structured training, significant at the one per cent level. Only the cultural and recreational services industry dummy returned a negative coefficient, but the difference is not significant. For on-the-job training this result becomes highly significant and, concentrating on the results in model 3, this is the only industry to return a coefficient significantly different from the excluded manufacturing industry. Family-owned businesses are also less likely to provide training, the results again more robust with respect to structured training.

Industrial relations

The BLS provided two indicators of union activity within the business: the proportion of employees who are members of a union (in 6 categories varying from 'none' to '76% to 100%') and the number of unions that represented employees of the business. Only the former had a (weakly) significant effect, and only in the case of structured training. The positive coefficient indicates that businesses provide more structured training when they are highly unionised. This may represent a direct effect of unions, or some other characteristics associated with industry or occupational sectors with high union coverage.

The results for the variables indicating the type of industrial relations arrangement covering the employment conditions of the majority of employees are difficult to interpret. Each is a dummy variable taking on a value of one if fifty per cent or more of employees are covered by that arrangement and zero otherwise, and they are jointly significant in all models. It seems that firms with registered enterprise agreements offer the highest level of structured training, while award coverage, individual agreements and unregistered enterprise agreements all provide more structured training than the default category. How this is interpreted depends very much on what we consider the 'comparison' category to be. Those without half or more of their employees in any one of these industrial relations categories comprised around 40% of the sample (1670 businesses). Of these, nearly three-quarters recorded no employees covered by any of these arrangements and many of these are very small operations with only a handful of employees. Relatively few reported multiple industrial relations arrangements within the one business.

On-the-job training seems most prevalent for businesses with award coverage. Again all four forms of industrial relations arrangements were associated with significantly higher training levels than the default category.

Business practices, plans and changes

Training incidence was higher in businesses that had a formal strategic or business plan, and which made formal performance comparisons with other businesses. The estimated effect is highly significant for both forms of training. A range of variables is available indicating major

changes that occurred during the year and business intentions for the next three years. Those found to be significantly related to higher training included an increase in the number of staff using computers, an increase in production technology and an increase in the application of administrative computer systems. For on-the-job training, a positive relationship with an increase in the range of products and services, export market targetting and an intention to commence or lift exports is also present. Somewhat paradoxically, the value of exports is negatively associated with structured and on-the-job training. As would be expected, there is a positive association between training intensity and plans to increase production, and a very strong negative association between training and an intention to close down the business. An intended decrease in production levels was not found to be significant, most likely due to low frequencies. The estimated percentage change in sales was not found to be significant in any of the models.

Research and development

Two of the variables available to indicate research and development activity are whether or not the business performed or paid another business to perform research and development (included as a dummy variable) and the total expenditure on research and development (in $'000s). The expenditure variable here is expressed as expenditure per person employed. In the case of structured training, the dummy variable dominated, and research and development activity was associated with a higher training effort by the business. In the models for on-the-job training, expenditure on research and development per employee proved the better specification. However, in this case the coefficient is negative, possibly reflecting a preference for formal training among innovative firms rather than on-the-job training.

Financial aggregates

Reporting of total income, total wages and salaries and total costs allowed calculation of income per employee, average wages per employee and the share of wages and salaries in total costs. Given existing evidence that more educated and highly paid employees tend to receive more training, we would expect a positive association between average wages and salaries per employee and training incidence. This hypothesis is strongly borne out in the results. Higher total income per employee is associated with a higher incidence of training in all models, but is not strongly significant.

Profits per employee are insignificant in the case of on-the-job training and attains only weak significance for structured training. The literal interpretation of the sign on the coefficient is that more profitable firms offer structured training to fewer of their employees. From a number of perspectives the reverse would have been expected, most obviously the view that training offers net benefits to the firm in the form of higher productivity and innovation. Alternatively, from an investment perspective, a negative relationship could arise if firms experience lower profits in years in which higher training investments are made, but higher profits in later years. The inclusion of the variable here raises questions of cause and effect. Is it training that impacts upon profitability, or profitability that impacts upon training? Later the longitudinal nature of the data is utilised to more thoroughly explore the former of these relationships.

The share of wages and salaries in the business' cost structure is strongly associated with higher on-the-job training but not structured training, suggesting that labour-intensive operations are more likely to rely upon on-the-job training relative to capital-intensive operations. Surprisingly, however, the level of capital per employee—measured as the value of non-current assets of plant and machinery—did not have the expected significant association with the level of provision of either form of training.

Who increased their training effort?

The analysis now turns to the factors that led businesses to increase their training effort. The variables we concentrate on are: whether there has there been a major increase in management and technical training during the last three years (1994–95 survey); whether there was a major increase in management training, on-the-job and other training during the last financial year (1995–96 and 1996–97 surveys); and whether the number of people being trained by the business increased in the previous 12 months (1997–98 survey). Although each of these questions included options for decreases as well as increases in training, so few respondents indicated any decrease in training levels that we can justifiably collapse the variables into one-zero dummies of whether or not there was an increase. The binary nature of the independent variable then lends itself to a standard logit specification. The regression results are contained in the appendix tables A2 to A5.

The longitudinal nature of the data can be utilised to investigate the temporal pattern of training responses with other business developments—do training responses coincide with, precede, or follow other business developments with a lag. Assuming we could accurately model the *level* of training provided by a business in periods t and t+1, then many of the fixed variables could be differenced out of the models when estimating the *change* in the level of training. For example, businesses in a certain industry may provide a higher level of training to their employees, but when comparing one period to the next, the industry effect would be a constant and should not be a reason for a change in the level of training. However, from the previous section it appears that the 'change in training' variables need also to be interpreted as reforms to training practices as well as measures of the actual level of training, such as training expenditure or the proportion of employees undertaking training. Hence some variables that might otherwise have been considered fixed are included in modelling the change in training.

Working chronologically, the first models investigate the likelihood that a business reported a 'major increase' in management or technical training in the three years to 1994–95. Consider the independent variables to fall into one of three categories:

- current variables, based on 1994–95 survey data: these include current aggregates, responses relating to changes that occurred in the past three years and responses relating to intentions for the coming years
- retrospective and historical variables: from 1995–96 onwards, firms' responses to questions in previous waves of the survey can be included. Some data were also collected retrospectively in the first wave of the survey (for example, employment levels are collected for 1993 onwards)
- future variables derived from responses in latter waves of the survey (except for when modelling training changes in the final 1997–98 wave)

The models for the likelihood of a reported increase in technical training and management training in 1994–95 are reported in table A2. The estimated coefficients in the first pair of columns are from models including only current variables—those collected in the 1994–95 wave of the survey. Several of the available variables derived from retrospective responses are included in the models in the centre columns, and future variables are included in the models reported in the two right-hand columns.

Results for the three training variables for 1996–97 (increase in on-the-job, management and other training) are shown in table A3, respectively containing models with current variables only (table A3a), current and retrospective variables (table A3b) and current and future variables (table A3c). There is a much wider range of retrospective variables now available in the second year of the survey. The same format is followed in tables A4a to A4c for 1996–97. There is only one dependent variable for 1997–98—whether there was an increase in the

number of people being trained by the business—and only current and retrospective variables are available. These models are reported in table A5.

If there is a positive association between a high-training culture and a culture of innovation or progressiveness, then we may expect to find positive associations between training variables and business reforms irrespective of which year each is measured. However, if associations hold only for the same year, it can be argued that training is simply a 'process' related to actual change rather than a contributing factor to innovation.

Current variables

We look first at the estimated coefficient for current variables. Across the models it is noticeable that many of the industry dummies remain significant, particularly in 1994–95. Note that 'a significant increase in training' for 1994–95 refers to a change in the previous three years, whereas the dependent variables in later years refer only to the previous 12 months. The positive association of reported increases in training and firm size, as measured by the number of employees, appears in most models, particularly with respect to management training. Again there is evidence of a negative second derivative in this relationship. The percentage of employees who were part-time or female, or the rate of turnover was not found to be a significant factor in reported changes in training effort (only the former is reported).

In terms of industrial relations arrangements, the level of unionisation of the firm's workforce does not have a strong association with training changes.[a] The coefficients are positive and weakly significant in the case of 'other training' in 1996–97 and for increases in the number of persons being training in 1997–98. Businesses with most employees on awards are consistently found to be more likely to report increases in training, as are those with registered enterprise agreements.

There is a range of variables indicating whether particular changes occurred in the previous twelve months, such as an increase in the range of products and services, an increase in advertising, administration computer systems, production technology and so on. The significant and (generally) positive coefficients for these variables show that training often accompanies developments within a business. An exception was for major increases in 'distribution'. In a number of models, businesses reporting this change were less likely to have increased training, possibly a reflection of the stage of the product life-cycle. A limited association appears between recent training changes and current intentions. The most robust of these is an increased likelihood of reporting an increase in training where the firm's intentions are to increase production. This is also the case for firms who reported a major recent innovation. The innovation variable is based upon whether the business introduced new or substantially changed products or services, providing further evidence of increased training efforts or training reforms accompanying other business reforms and innovations. This relationship is explored in more detail in the following chapter.

One of the strongest and most consistent findings is that businesses that have a formal business/strategic plan and, to a lesser extent, that make formal comparisons with other businesses, were also more likely to report increased training. For 1994–95, there is evidence that firms paying higher wages per employee were more likely to have increased technical training. However, in some other models this variable was associated with lower levels of training, albeit only at low levels of significance. There was no evidence that firms with higher profits were more likely to report increases in training, nor firms with higher capital to labour ratios (not reported).

[a] The original coding in the BLS is used for this variable, ranging from 1 = no employees in a union, 2 = up to 10%; 3 = 11% to 25%, 4 = 26% to 50%; 5 = 51% to 75% and 6 = 76% to 100%.

Retrospective/historical variables

We turn now to the effect of past variables. The inclusion of these reduces the number of observations available in the estimation as only firms that responded to both years' surveys can be included. Only a handful of retrospectively collected variables are available for 1994–95. Those included are changes in employment from 1993–95, in the proportion of employees employed part-time and in the value of exports per employee. For 1995–96 and 1996–97 a large range of variables can be included, either as levels or as derived changes in the variables from one year to the next.

It is clear from the results that the recorded developments in past years have little bearing on recent initiatives. None of the retrospective variables included for 1994–95 are significant. Businesses that reported upgraded administrative computer systems in 1994–95 were more likely to report an increase in the three types of training in 1995–96, the result being significant at the 5% level (table A3b). A similar but stronger effect occurs for 'an increase in production technology' in the 1996–97 models (table A4b). Innovations in the year preceding the current survey are actually found to reduce the probability of the business reporting increased training. This probably reflects the tendency for training to increase at the time of the innovation. Indeed if training activity is specific to the process of implementing the innovation, training incidence may fall in the following year. The implementation of awards, registered enterprise agreements and business plans also attracts negative coefficients in some models, despite these factors otherwise being associated with increases in training. This suggests that the training effect of these arrangements takes at least one year to materialise.

Most surprising is that the variables measuring business intentions from the previous year are rarely significant, even though by nature the variables themselves should be forward-looking. Further, the signs on the coefficients for these variables are just as often counter-intuitive. For example, businesses that reported in 1995–96 that they intended to increase production were more likely to report increased on-the-job training in 1996–97, but the opposite result was attained for the 1997–98 model. Per-employee changes in profits, the value of exports and wages or changes in the share of wages in total costs from the previous years also failed to display any significant relationship with training increases.

Future variables

Reponses to training changes in the survey years can also be mapped to business developments in latter waves of the survey. It must be admitted that this is an unorthodox way to set up the model—it is effectively 'predicting' past values. Again it raises questions of the direction of cause and effect. The approach implies that future business developments arise out of (and can be used to proxy) a set of current circumstances and that these circumstances may also impact upon training activity. If increased training is actually a causal factor in generating future changes, we would also expect to observe significant correlations between training and future developments. However, the orthodox approach would be to include training changes as an explanatory variable, and the other developments as dependent variables. This is the approach taken in the following chapter.

We find limited evidence of training preceding other business changes, with very few consistent results across the models. The implementation of business plans and business comparisons in the following year is associated with higher reported training, particularly management training, in the current year in several instances. The other consistent relationship is between current training changes and future increases in production technology. The most plausible explanation for this is that, in preparation, some of the associated increase in training for updated production technology actually precedes its implementation. Future increases in advertising and in the share of wages to total costs are also positively associated with increased training effort in two models. Results relating to the future opening of locations are contradictory for 1994–95 and 1996–97 models. A further

generation of variables (t+2) can be added to these models, but with rare exceptions, these effects are not found to persist beyond the one-year horizon.

Apart from the significance of individual variables, it is also the case that the inclusion of future variables fails to improve the predictive ability of the models, in terms of the proportion of concordant observations.[7] However, the direct comparisons of the proportion of concordant observations are not strictly valid since the models with and without future variables are estimated across slightly different samples. If the samples are restricted to only those firms which can be included for both the current and expanded models, then the addition of the future variables does marginally improve the predictive power of the models.

Summary

A scan of the variables which attain significance in the reported models reveals that nearly all relate to the current year. The results thus provide strong evidence that changes in training occur in tandem with other business changes and innovation—at least within the same twelve-month time frame. Hence it is clear that training is used to facilitate new developments within a business. There is very little evidence that changes or innovation within a business have an ongoing effect on training, and only marginally better evidence that current training changes are associated with future business changes. Even with more robust results, it is likely that it would be difficult to disentangle issues of cause and effect. Increases in managerial training, for example, do appear to precede the implementation of business planning and business comparisons, but is training just one of the tools used in the process, or does greater training give management the skill to formulate and implement such business practices, and hence bring about the changes? There is evidence that larger firms and firms with certain industrial relations arrangements, namely awards and formal enterprise agreements are more frequent training innovators, but other financial characteristics, such as profits per employee, capital-to-labour ratios, wages and export intensity were not found to be associated with training changes.

[7] That is, the proportion of observations for which the observed outcome for the training variables is consistent with that predicted by the fitted model.

Training and innovation

It may be that seeking a direct causal link between training and increased productivity would miss some of the main benefits to firms from investing in training. It is possible that a firm's training effort is an integral part of an overall culture that promotes innovation, adaptability and a more rapid take-up of new technology and progressive work practices. If this is the case, there need not necessarily be any direct correspondence—in terms of timing or magnitude—between training initiatives and changes in firm performance. Rather, over a more extended time frame, a superior learning culture will enable the firm to innovate and to exploit external opportunities more effectively than competitors. The timing and extent of the actual competitive gains realised may relate more closely to the timing and nature of technological break-throughs or other opportunities arising in the external environment. Such an ability to foster a 'learning' organisation is argued to be increasingly important in the emerging global information economy.

This chapter reviews recent Australian contributions to the literature on the concept and determinants of innovation before applying the BLS data to investigate the linkages between training and innovation in Australian firms. Rogers discusses the definition and measurement of innovation (1998b). The determinants of innovation have been analysed using Australian Workplace Industrial Relations Survey data (Rogers 1999) and ABS data (Phillips 1997). Phillips (1997) and Laplagne and Bensted (1999) look at the role of innovation and firm performance. The next chapter will consider the take-up of the internet and e-commerce as an applied example of the diffusion of an innovation, and the issue of the linkages between training, innovation and firm performance is addressed in the final chapter.

What is innovation?

Innovation is often defined broadly in terms of the application of new ideas or inventions. Rogers (1998b) supports the notions of innovation first outlined by Joseph Schumpeter over the course of the 1930s. Schumpeter outlined five main types of innovation (as summarised by Rogers, p.6):

- introduction of a new product or a qualitative change in an existing one
- process innovation new to an industry
- the opening of a new market
- development of new sources of supply for raw materials or other inputs
- changes in industrial organisation

Closely related to these, Laplagne and Bensted (1999) use workplace changes reported in AWIRS as indicators of innovation at the firm level. The OECD (1997) outlines an approach to measuring innovation that concentrates on the first two measures. This approach describes innovation as measurable in the sense that it results in either new final products or readily described developments in the production process. The former of these is referred to as *technological product innovation*, while the latter as *technological process innovation*. It should be noted that technological process innovation is distinguished from organisational innovation which relates to the improvement in managerial or organisation structures within a firm.

The Australian Bureau of Statistics (1996) in its innovation survey defines innovation as:

> *... any new or substantially improved good or service which has been commercialised, or any new substantially improved process used for the commercial production of goods and services. 'New' means new to your business.*

Rogers (1998b) classifies measures of innovative activity in terms of outputs and inputs. Outputs are those measures which indicate firm performance in the market place or the placement of new product. Input measures include indicators of internal firm performance on the basis of input use or gains in the efficiency thereof. Output-based measures include standard firm performance measurements such as sales revenue, profits and share market capitalisation. Problems with this type of measurement relate to the wide range of factors which can affect each one of these output variables. When using such dependent variables it is important to be aware of the potential effects of other factors, such as general economic conditions and the impact of changes in organisational or management structure.

Input measures of firm innovativeness include patent applications and the level of research and development expenditure at the corporate level and the measures of its success. Patent data are often considered to be both an input and output from the firm. It is an input to the extent that it includes processes and products which assist in the final production of the firm's goods and services. A problem with patent data, according to Griliches (1990), is that patents differ vastly in their economic value, and hence raw patent numbers need to be adjusted for this. Expenditure on research and development also differs dramatically between industries, which needs to be taken into account if R&D expenditure is to be used as a proxy for innovation.

The level and determinants of innovation

Previous literature has suggested that workplace size is an important determinant of innovation. Rogers suggests that this may be because larger firms have greater access to capital, market power, a research base and government programs (1999, p.6). His own analysis of data on Australian workplaces, drawn from the 1990 and 1995 AWIRS, found that larger firms, firms with better employee-management communications and higher levels of training were more likely to be innovative. For each of three measures relating to a major restructuring of how work is done, a re-organisation of management structure and introduction of major new plant, equipment or office technology, respectively, sixty to seventy per cent of firms reported at least one major change in the past two years. Major changes in products or services were less frequent, with less than a third of firms reporting this form of innovation.

The ABS has surveyed Australian manufacturing firms in relation to technological innovation, or 'technologically new, or substantially changed, products or new, or substantially changed, processes'. In total, around one-third of firms reported undertaking innovation in the three-year period from 1991–92 to 1993–94. This ranged from 29.1% for small firms to 79.3% for large firms; and from 26.3% for non-exporting firms to 68.8% for exporters. The main barriers to innovation included a lack of finance/high cost of innovation, a lack of skilled personnel and long pay back periods.

It is generally expected that better trained and qualified staff are more likely to be innovative, suggesting a link between education, training and innovation. The series of matched plant studies by the National Institute of Employment Studies demonstrated the superior take-up of new technology and work practices for firms based in countries which had a higher level of VET.[*] This, along with a direct link between worker education and their 'ability to be innovative' has been supported in other empirical studies (Blundell et al. 1999). Using data

[*] Daly, Hitchens and Wagner (1985), Steedman and Wagner (1987, 1989), Prais, Jarvis and Wagner (1989), Mason, Prais and van Ark (1992).

collected from both US firms and their employees, Frazis et al. (1998) also find that firms which use 'more innovative workplace practices' also tend to train more. Laplagne and Bensted (1999) find that both training and innovation are more prevalent in Australian workplaces with higher productivity growth, and that the introduction of both innovation and training jointly offers synergistic benefits. However, the nature of the relationship between training, innovation and performance differs between technically efficient and technically-inefficient firms. They interpret innovation among technically inefficient firms as a process of reforms to 'catch-up' with competitors, and find training to be less effective for these firms.

Innovation and the BLS

The BLS included questions designed to solicit indicators of innovation consistent with the above definitions and in line with those used by the ABS and in AWIRS. The indicators of innovation and their availability across the survey are set out in table 10.

Table 10: Summary of innovation variables available in the BLS CURF

	1994–95	1995–96	1996–97	1997–98
Non-manufacturing businesses:				
Did this business:				
❖ introduce new services or changed ways of delivering services?	✓			
❖ introduce any new or substantially changed goods?	✓			
❖ introduce any new or improved services?		✓	✓	✓
❖ introduce new or improved procedures for the supply of services?		✓	✓	✓
Manufacturing businesses:				
Did this business develop or introduce any new or substantially changed products or services?	✓	✓	✓	✓
If 'yes', what was the estimated expenditure on the development of the new products or process for:				
❖ R&D	✓	✓	✓	✓
❖ training of staff	✓	✓	✓	✓
❖ acquisition of patents, trademarks, licenses	✓	✓	✓	✓
❖ tooling-up, industrial engineering, manufacturing start-up	✓	✓	✓	✓
❖ marketing new products	✓	✓	✓	✓
❖ other		✓	✓	✓
❖ total expenditure	✓	✓	✓	✓
Did this business perform, or pay other businesses to perform R&D activity during the year		✓	✓	✓
If 'yes' to the above, the value of expenditure on R&D		✓	✓	✓

There seems some discrepancy between the available variables in the CURF file and those that can be derived from the actual questionnaires. In the third and fourth years, the CURF files contain variables which apparently indicate whether or not the business performed or paid other business to perform R&D, and if so the value of expenditure. However, this question was only asked directly of all firms in the second year (1995–96). Presumably in the final two years it is inferred from the answers regarding expenditure on R&D arising from the development of new products, services or processes. Hence firms that performed or paid for R&D, but had not undertaken any innovation, would be included as having performed or paid for R&D in 1995–96, but would be excluded in 1996–97 and 1997–98, making this variable and the expenditure on R&D incomparable over these years.

As can be seen, the questions relating to new or substantially changed product, services or process vary for manufacturing and non-manufacturing firms, and slightly for non-manufacturing firms after the first year. In table 11, we collapse these questions into one dummy 'innovation' variable indicating whether or not any one form of innovation was acknowledged for that year. The number reporting an 'innovation' increases markedly in the second year. As the increase is across all industry and firm-size categories, it appears this is related to the framing of the survey questions. Among the industry categories, mining and construction firms appear to stand out as very low innovators, while the likelihood of an innovation occurring also increases with firm size.

Table 11: Proportion of firms reporting an innovation by industry and firm size

	1994–95	1995–96	1996–97	1997–98
Industry				
Mining	5.0	9.4	9.8	7.6
Manufacturing	25.0	30.5	20.6	19.9
Construction	6.2	15.2	11.6	10.9
Wholesale	19.0	24.5	31.2	29.8
Retail	10.6	22.5	19.2	19.5
Accom, café & rest.	8.9	21.7	16.5	16.7
Transport & storage	7.6	20.2	16.7	17.8
Finance & insurance	8.6	19.8	18.8	17.5
Prop & bus. svcs.	9.2	23.5	19.0	19.4
Cultural & rec. svcs.	9.2	26.3	14.8	22.0
Personal & other svcs.	11.5	18.4	18.8	19.0
Total	**16.2**	**25.0**	**20.6**	**20.3**
No. of employees				
1 to 4	7.8	15.1	9.4	9.7
5 to 9	12.0	22.0	17.0	16.1
10 to 19	18.5	27.2	24.4	22.2
20 to 49	23.5	33.0	27.3	24.8
50 or more	26.8	31.8	29.7	33.6
Total	**16.2**	**25.0**	**20.6**	**20.3**

The link between research and development measures and innovation may be somewhat tenuous, but Rogers (1998b, p.13) notes that their wide availability and expected correlation with innovation make it a popular proxy for econometric work. Table 12 shows that there is also a link between firm size and the likelihood of undertaking, or paying another firm to undertake, R&D. The tenuous link between this measure and the measure of innovation above can be seen from the fact that the mining industry is reported as a very high participator in R&D, but a very low innovator in terms of implementing new products, services and processes. There are very high standard errors associated with calculating R&D 'intensity' ratios such as R&D expenditure as a percentage of total sales or per employee for individual industries, and the results tend to be strongly influenced by outliers. Thus these are not reported. For the sample as a whole, the average R&D to sales ratio ranged from 0.3% in 1995–96 to 0.5% in 1997–98. When the sample is restricted to firms who did undertake R&D, the average ranged from 1.3 to 2.6%.

The analysis that follows concentrates on the most basic measure of whether or not the firm 'innovated' by developing or introducing new or substantially changed products, services or processes. There is no clear-cut expectation as to the distribution of the innovation variable between firms or over time. A high-training firm can be expected to show a high proportion of employees receiving training in each year, but we may not expect an 'innovative' firm to report an innovation in every year. If we imagine innovations to have a life-cycle, akin to a product life-cycle, then it depends upon the duration of that cycle as to how likely we are to observe an innovation taking place during the four reference years of the survey. It can only

be expected that the likelihood of observing an innovation taking place within the four years is higher for more innovative firms.

Table 12: Proportion of firms undertaking R&D, by industry and firm size

	1995–96	1996–97	1997–98
Industry			
Mining	22.6	14.8	18.2
Manufacturing	18.8	16.4	16.9
Construction	2.7	3.6	2.4
Wholesale	5.1	6.8	8.5
Retail	1.5	3.7	2.3
Accom, café & rest.	1.4	2.0	2.4
Transport & storage	3.5	2.5	3.5
Finance & insurance	2.7	3.1	3.5
Prop & bus. svcs.	7.4	6.5	8.3
Cultural & rec. svcs.	2.5	4.9	7.9
Personal & other svcs	0.0	1.7	1.7
Total	**9.6**	**9.0**	**9.6**
No. of employees			
1 to 4	3.1	3.1	3.2
5 to 9	3.6	4.6	6.5
10 to 19	9.5	9.5	8.1
20 to 49	14.5	14.0	13.5
50 or more	19.5	15.9	19.3
Total	**9.6**	**9.0**	**9.6**

That said, there is a statistically significant correlation between an innovation taking place in any two years of the survey (table 13), although the degree of correlation is not great. This does suggest some degree of continuous innovation. In fact, looking only at firms that remained in the survey for all four years, around half reported no innovation over the four years and one-quarter recorded one innovation, leaving one-quarter reporting innovations in more than one year. Only 4% reported an innovation in every year of the survey.

Similarly, there is a statistically significant but moderate correlation of typically around 0.25 between a firm undertaking (or paying for) research and development and that firm reporting an innovation. The correspondence between R&D activity from one year to the next is far larger, indicating that R&D activity is a more continuous process.

Table 13: Correlation coefficients between occurrence of innovation and R&D activity over time

	Innov'95	Innov'96	Innov'97	Innov'98	R&D'96	R&D'97	R&D'98
Innov'95	1.00						
Innov'96	0.27	1.00					
Innov'97	0.23	0.28	1.00				
Innov'98	0.20	0.22	0.37	1.00			
R&D'96	0.27	0.24	0.21	0.20	1.00		
R&D'97	0.25	0.23	0.44	0.24	0.50	1.00	
R&D'98	0.23	0.20	0.28	0.46	0.43	0.55	1.00

Note: All coefficients significantly different from zero at the 1% level.

Innovation and training?

To investigate the role of training in innovation, the likelihood that the firm reported an innovation in any of the four years of the survey and the likelihood that the firm reported undertaking R&D in any of the last three years, are modelled as permitted by the available

data. Given the nature of innovative activities and R&D as described above, it is expected that this will provide a better indicator of innovativeness or R&D activity than using dependent variables based on data for a single year, and thus the sample is restricted to firms that remained in the survey for the full reference period. As the mid-year, the 1996–97 values are used for the explanatory variables unless otherwise specified in appendix table A6.

Commenting briefly on the non-training related variables, both the number of employees and its square are included and the results confirm previous findings that there is not a simple linear relationship between firm size and innovation. Innovation increases with size, but at a diminishing rate. Firms from the mining and construction industries are less likely to report an innovation over the survey period, while wholesalers and those in the accommodation, café and restaurant industry are more likely to do so. Intentions to increase production or exports are associated with innovation, yet exporting firms themselves are not found to be significantly more innovative. There is a negative association with capital per employee and reported innovation, but no such relationship is identified between either profit or wages per employee. The strongest effect identified is between the research and development variable. This is a dummy variable defined according to whether the firm undertook, or paid another firm to undertake, research and development in any of the three years in which the variable was collected (1995–96 to 1997–98). The positive association of research and development with innovation is reaffirmed after controlling for these other variables.

Although the timing of collection of the training variables and the periods to which they relate vary, there is a consistent pattern linking innovation with higher levels of training or increased training. The variables capturing changes in the level of training include whether there was an increase in the proportion of employees receiving management training in the three years to 1994–95, in 1995–96 and in 1996–97; whether there was an increase in technical training in the three years to 1994–95; whether there was an increase in on-the-job training in 1995–96 or 1996–97 and whether there was an increase in the number of people being trained in 1997–98. With the exception of the latter, all these are positively associated with innovation at a high level of significance. As with other business changes, this is consistent with the need for training changes arising out of the implementation of innovations in the workplace. Paradoxically, an increase in the number of employees receiving training in the last year is negatively associated with innovation, although the effect is not as strong in magnitude or statistical significance. This may be because changes in training activity more often lead rather than lag innovations, and those firms that increased training in earlier years were less likely to do so in the final year of the survey. Of the two measures of the level of training, the proportion of employees receiving on-the-job training in 1997–98 is positively and significantly associated with innovation, although no effect appears for structured training.

The results are quite different with respect to R&D activity, confirming doubts as to whether R&D expenditure or activity is an acceptable proxy for innovation. The relationship between training and undertaking research and development is far weaker than in the case of innovation. Another noticeable difference for R&D is the absence of the firm size effects that are such consistent determinants of other variables relating to training and innovation. The industry effects confirm that mining displays a high degree of R&D activity, but is a low innovator. All other industries display significantly lower degrees of R&D activity than manufacturing, but only firms from the mining and wholesale industries display a significantly different level of innovation. Thus manufacturing firms are strong on R&D, but are not particularly innovative. There also appears to be stronger links between export activity and R&D than there is for innovation.

Leading and lagging firms

As noted above, Laplagne and Bensted (1999) find differences in the relationship between training and innovation for technically efficient and technically inefficient firms. The argument can be interpreted as being that technically efficient firms are genuine 'innovators', while inefficient firms simply mimic their leading competitors in an effort to catch up, and it is

only in the case of the true innovators that training is an important determinant of innovation. Here we test for this phenomenon by first estimating basic models of firm productivity and financial performance to identify efficient and inefficient firms.

Laplagne and Bensted test for this difference by splitting their sample into two 'efficient' and 'inefficient' sub-samples, and estimating the role of training and innovation on firm performance for each sample. They note that splitting the sample can lead to bias estimates. Instead, the approach taken here is to create interaction terms between the training variables and whether the firm is a leader or laggard. Five measures of efficiency are tested—return on equity, profit margin, return on assets, profit per employee and the ratio of profit to wages. Denoting the performance measure by Y, a simple linear regression model is estimated of the following form:

$$Y_i = \alpha + \phi EMP_i + \chi EMP_i^2 + \beta_j IND_{ji} + \varepsilon_i$$

That is, performance is a function of the number of employees, the number of employees squared and the industry of the firm. From fitting each equation to the observations, a predicted value for the performance measure can be calculated for each firm, and the residual calculated as the observed value minus the predicted value. Thus 'efficient' firms will have positive residuals and 'inefficient' firms negative residuals.

The interaction terms are then created such that there are now two variables for each of the training variables previously included in table A6. For example, whether or not the firm recorded an increase in management change was previously a single dummy variable with value 1 or 0. The two new variables are defined as follows:

- low performer: takes on a value of 1 if the firm is a low performer and it increased management training, zero otherwise
- high performer: takes on a value of 1 if the firm is a high performer and it increased management training, zero otherwise

The expectation is that the second of these variables should show a stronger link to innovation, and so too for the other high-performance/training variables over their low-performer training counterparts. Appendix table A7 reports the results for each of the five models estimated using the different performance measures to distinguish between leading and lagging firms. They do not support the idea of markedly different relationships between training and innovation for efficient and inefficient firms. Based on the magnitude and significance of the training variables, the impact appears remarkably similar whether the training has been undertaken by a high-performance or a low-performance firm. Most training variables are associated with a higher likelihood of reporting an innovation across the models, the exception again being an increase in the number of employees receiving training in 1997–98.

Internet take-up and e-commerce

The adoption of new and emerging technologies into the process of production and the delivery of services are major components of innovation. There can be little doubt that the continued development of applications of the internet represented one of the most fundamental changes to the world of business in the 1990s. Hence the take-up of internet-based activities provides an opportunity to study innovation in the context of a specific technology.

Table 14: Summary of internet and e-commerce variables available in the BLS

	1995–96	1996–97	1997–98
Has there been major increase/decrease in electronic banking or funds transfer in the previous 12 months?		✓	
Has there been major increase/decrease in electronic ordering/purchasing via the Internet or otherwise in the previous 12 months?			✓
Did this business use electronic commerce (other than banking)?	✓	✓	
Does this business have its own web site/ home page?		✓	
Does this business access the internet?		✓	✓
Does the business use the internet for purchasing?		✓	
making payments?			✓
placing purchase orders?			✓
receiving invoices?			✓
Does the business use the internet for selling?		✓	
web site/home page?			✓
other marketing, promotion?			✓
receiving payments?			✓
sending invoices?			✓
receiving sales orders?			✓
co-ordinating delivery arrangements?			✓
Does the business use the internet for:			
marketing or advertising?		✓	
gathering information?		✓	✓
voice/video communication?		✓	
email?		✓	✓
data transfer?		✓	
business-to-business data transfer?			✓
interactive lodging of forms/tenders?			✓
business networking?			✓
intranet?			✓
other?		✓	✓

The BLS collected a range of data items relating to the take-up of the internet and related activities, including e-commerce. As set out in table 14, these are concentrated in the 1996–97 and 1997–98 surveys. Selected frequencies for 1996–97 are reported in table 15. The most commonly reported use of the internet was for marketing, with very few businesses actually

purchasing or selling via the internet. Just over 15% of businesses reported using e-commerce. There was considerable inter-industry variation in the level of adoption of the internet by 1996–97. Businesses in cultural and recreational services, finance and property services and mining seem to have been the most ready to embrace this innovation. Given the potential for e-commerce to reshape the nature of retailing, it seems surprising that only a marginally higher proportion of businesses in this sector reported using e-commerce compared to the overall average, and that a very low proportion reported having a web site. There is a very strong pattern of increasing take-up of internet-related applications with firm size.

Table 15: Proportion of businesses using the internet and e-commerce 1996–97, by industry and firm size

	Uses e-commerce	Accesses internet	Uses internet for:			Has web site
			Purchasing	Selling	Marketing	
Industry						
Mining	24.6%	57.4%	4.9%	0.0%	13.1%	24.6%
Manufacturing	15.2%	38.3%	1.1%	0.7%	7.6%	12.6%
Construction	6.3%	19.5%	1.3%	0.0%	2.6%	4.6%
Wholesale	22.6%	47.1%	0.0%	0.3%	3.6%	10.3%
Retail	17.8%	23.3%	0.2%	1.8%	4.6%	3.5%
Accom, café & rest.	14.0%	17.5%	0.0%	1.0%	13.5%	8.5%
Transport & storage	16.7%	24.7%	0.0%	2.0%	9.6%	12.1%
Finance & insurance	22.4%	49.8%	0.0%	0.0%	1.8%	9.4%
Prop & bus. svcs.	16.3%	54.6%	0.4%	2.6%	17.7%	19.4%
Cultural & rec. svcs.	13.9%	42.6%	2.5%	6.6%	22.1%	27.0%
Personal & other svcs.	3.4%	19.7%	1.7%	2.6%	6.8%	7.7%
Total	**16.4%**	**38.3%**	**0.7%**	**1.2%**	**8.3%**	**11.8%**
No. of employees						
1 to 4	6.5%	24.4%	0.7%	0.7%	3.2%	4.0%
5 to 9	10.5%	26.3%	0.6%	1.2%	4.9%	7.3%
10 to 19	15.8%	34.2%	0.4%	1.6%	6.2%	8.2%
20 to 49	21.6%	45.9%	0.4%	1.0%	9.7%	14.9%
50 or more	31.4%	65.4%	1.3%	1.9%	19.4%	27.3%
Total	**16.4%**	**38.3%**	**0.7%**	**1.2%**	**8.3%**	**11.8%**

We concentrate on three main indicators of internet take-up to investigate whether the level of training undertaken in the businesses is a factor in this innovation: the use of e-commerce; whether or not the business used the internet for one of the range of uses outlined in table 14 and whether or not the business had its own web site. All are derived from the 1996–97 survey. The inclusion of other variables measuring innovation, major changes or R&D is problematic here, as the responses might actually be directly related to implementation of e-commerce or the internet, and hence it would be spurious to consider them as causal factors. Another limitation is that there are few measures of the actual level of training provided in the business prior to 1997–98, and hence the 'major change in training' variables need to be taken as indicators of training effort in other years.

The logit model estimations (table A8) confirm the strong but declining effect of firm size on early take-up of the internet, and the relatively slow take-up by the retail sector. The finance industry has been quick to use both e-commerce and the internet, but businesses in this sector are not more likely to actually have their own web site. The take-up of all three applications was more prominent among firms that had formal business or strategic plans, and the use of e-commerce was markedly higher for those firms which made formal business comparisons. Another factor positively associated with take-up rates in all three models was the level of wages per employee. This is consistent with more skilled (and higher paid) workers adapting more readily to new technology, and/or with the utilisation of computers and being more prominent within professional occupations. Businesses with intentions to increase exports also

displayed higher take-up rates, and exporting firms were significantly more likely to use the internet.

Focussing on the training variables, it does appear that increases in management training in the current year were associated with the use of e-commerce, and weakly significant relationships are observed between increased on-the-job training and internet use (5% level) and having a web site (10% level). Historical values of the change in training variables were tested (not reported) and found not to be significant for any of the three measures of take-up. The most robust results are obtained for the 'level' of structured training one year ahead. Firms in which a greater proportion of employees received structured training in 1998 were more likely to have embraced all three innovations in the previous year. This is consistent with a high level of formal training being a component of an innovative firm culture. However, the relationship does not extend to on-the-job training. Firms in which a higher proportion of employees received on-the-job training were actually less likely to utilise the internet (significant at the 10% level) or to have a web site (5%). It is likely that this relationship is actually capturing other industrial or occupational effects associated with jobs in which on-the-job training is more frequent. This highlights again the point that caution must be taken in interpreting the results as there is sure to be a number of important omitted variables which may be correlated with those that are available for the estimation.

Training, innovation and firm performance

Finally, this section addresses the question of whether more innovative firms and those which provided a higher level of training performed better than others over the period of the longitudinal survey. On balance, previous work using the BLS and other such firm-level data to explain accounting-based variations in performance and profitability has not been particularly successful in Australia (see Rogers & Tseng 2000; Northwood 1999; Rogers 1998a; Feeny & Rogers 1998). Analysis using reported qualitative assessments on relative performance and productivity, or improvements in different aspects of performance and productivity, such as those available in the AWIRS data, has generally proven to be more fruitful (Laplagne & Bensted 1999; Drago & Wooden 1992). Using BLS data, Feeny and Rogers find that the use of alternative measures of profits can lead to different conclusions regarding firm performance (1998, p.32). Northwood (1999) suggests that the BLS data is 'not well suited to the modelling of within-firm changes over time', having been able to explain only a small proportion of the variation in measures of firm profitability other than via the inclusion of lags of the explanatory variable. It would be overly optimistic here to expect to improve on these previous attempts to model firm performance, but rather the aim is to explore more thoroughly the linkages with training and innovation.

Drawing on previous work, return on equity, return on assets and profit margin were investigated as measures of firm profitability. In addition, sales and total income, in gross and on a per-employee basis, were tested so as to provide measures that are not reliant on the derived profit variable. This included specifications based on both levels and growth. Simple descriptive statistics reveal the return on equity (defined as profit as a percentage of total owners' equity) to be a poor measure, with extreme values and a very high dispersion, whatever variable is used for weighting. Results based on this measure are not reported. These limitations also apply to the other measures, although to a lesser extent.

Despite extensive exploration of the data though cross-tabulations and calculations of means, it has not been possible to glean any convincing relationship between the variables for 'major changes' in training and the performance measures. The same holds for the levels of training as reported in the 1997–98 wave of the survey, although the results for these seem more orderly. To illustrate the point, table 16 presents means for return on assets, profit margins and the change in sales per employee for 1998, according to the proportion of employees in structured and on-the-job training, and whether or not the firm reported an innovation in the four years of the survey.

The table reinforces Feeny and Rogers' observation that conclusions on firm performance are likely to differ depending upon the measures selected, and the influence of outliers is readily apparent. A positive relationship is perhaps discernable between the incidence of structured training and increases in sales per employee, however, multivariate analysis and further data refinements are required to determine the existence of this or other such effects. Initially we concentrate on the levels for return on assets, profit margins and profit per employee. Sales and total income per employee will be poor proxies for either profitability or real productivity. The proportion of value-added in sales will vary considerably according to the specific nature of the operation and how the value-added chain is structured from an accounting perspective. However, concentrating on growth in these variables will largely control for the specifics of the operation, and for individual firms such measures are commonly used as a gauge of performance.

Table 16: Means for selected performance measures by training level and whether reported an innovation, 1997–98

	Return on assets[1] (%)	Profit margin[2] (%)	Increase in sales per employee[3] ($'000)
Prop. of employees who participated in training (1997–98):			
Structured training—none	4.6	2.8	4.8
1% to 25%	7.8	12.5	7.2
26% to 50%	5.2	5.6	16.7
51% to 75%	6.5	9.5	20.4
76% to 100%	6.9	6.8	17.4
On-the-job training—none	5.4	3.3	19.8
1% to 25%	8.5	8.4	7.1
26% to 50%	7.0	6.8	8.1
51% to 75%	5.9	20.4	13.7
76% to 100%	3.4	2.6	6.1
Did not report an innovation	7.0	15.7	5.6
Did report an innovation	6.5	4.7	1.0

Notes: 1. weighted by total assets; 2. calculated as profits as a percentage of sales, weighted by sales; 3. weighted by total employment.

The level of performance

Careful consideration needs to be given to the possibility of endogeneity in selecting variables to be included in the models. The variables relating to business intentions offer an example where profitability is likely to shape intentions, rather than the other way around. Most obviously, an intention to expand (close) the business is likely to be a result of the business being highly profitable (unprofitable). Hence none of the 'intention' variables are excluded. The range of variables indicating whether major changes took place in the business is similarly problematic. Businesses that are performing badly may be forced to make many changes and our preferred specification is to exclude these variables from the models. In any case, a summary variable indicating the number of major changes reported to have taken place in the business was tested and was not found to be significant.

Again omitted variables, such as market power, will be important and many of these will be idiosyncratic to individual firms. Aggregate variables relating to the fortunes of overall industries and geographic regions of firms will also be important. Northwood (1999), for example, found a set of State dummies to be one of the few significant variables related to firm performance. However this variables is not available in the CURF file.

Linear regression models were estimated using returns on assets, profit margins and profits per employee with a variety of specifications.[9] In each year, less than ten per cent of the variation across firms could be explained by the models, even when outliers were excluded.[10] In several cases, only around one or two per cent of variation could be explained. The models thus have very weak explanatory power, although most still attained high significance for the F-test. Further, the signs on coefficients were often counter to expectations and the same variables switched signs in different models even when reaching significance. It seems considerable more work is needed, particularly with respect to model specification, to

[9] A common approach would be to estimate total factor or labour productivity in a production function framework, such as a Cobb–Douglas production function. Such an approach has not been explicitly modelled here. However, given the available data, several of the specifications tested would have been close approximations or transformations of the production function model, suggesting further re-specification was unlikely to offer substantial improvement in the results.

[10] The one per cent of the sample with the highest and one per cent of the sample with the lowest values for the dependent variables were removed. This typically resulted in only around a one percentage point gain in the adjusted R-squared for the model.

adequately model firm performance with the BLS data. As a result, the complete results for the regression models are not reported. Instead, table 17 shows a tabulation of the variables achieving significance at the 10% level or better.

Table 17: Variables attaining significance at the 10% level or higher—firm performance models.

Sign on coefficient	Dependent variable		
	Return on assets (%)	Profit margin (%)	Profit per employee ($'000)
1995: +ve	Property & bus services Liabilities/assets ratio		Mining industry Finance industry Property & bus services Makes bus. comparisons Most emps on ent. agmt (registered) Capital/employee
-ve	Prop union members	Finance industry	Increased training Wage share of total costs
1996: +ve	Employment squared Construction industry Property & bus services Capital/employee (Capital/employee)$^{1/2}$ Wage share of total costs Liabilities/assets ratio	Finance industry Capital/employee	Mining industry Finance industry Most emps on ent. agmt (registered) (Capital/employee)$^{1/2}$
-ve	Total employment Family business Most employees on award - Individual agreement	Mining industry (Capital/employee)$^{1/2}$ Wage share of total costs	Total employment Increased training (t-1) Wage share of total costs
1997: +ve	Employment squared Construction industry Property & bus services Personal services industry Capital/employee Wage share of total costs	Total employment Finance industry Property & bus services Prop union members Capital/employee	Mining industry Finance industry Prop union members Most emps on ent. agmt (registered) Capital/employee
-ve	Total employment Family business Most emps on indiv agrmt Innovation (t-2) Business uses computers (Capital/employee)$^{1/2}$ Liabilities/assets ratio	Employment squared Increased training (t-2) Business uses computers (Capital/employee)$^{1/2}$ Wage share of total costs Liabilities/assets ratio	Wage share of total costs
1998: +ve	Finance industry Property & bus services Capital/employee	Total employment Property & bus services Undertook R&D (96–98)	Finance industry Most emps on indiv agrmt Capital/employee
-ve	Family business (Capital/employee)$^{1/2}$ Liabilities/assets ratio	Innovation (1995–98) Capital/employee	New business Formal strategic/bus plan

Note: $^{1/2}$ indicates the variable has been entered as the square root of the value.

A number of variables was regularly found to be significantly associated with performance measures. The finance industry, property and business services and mining regularly appeared as high performers. This of course is likely to reflect cyclical conditions in these sectors at the time of the survey. The value of capital (plant and machinery) per employee was also consistently associated with better firm outcomes. However, opposite results were obtained for the finance industry dummy and the capital-to-labour ratio in models of profit margins. The ratio of liabilities to assets and of wages to total costs were negatively associated with performance in many models tested, but again positive associations were also significant on other occasions. In some models, the sign on the coefficient for employment was positive and the sign on its square negative, but the reverse was also the case in others. Curiously, the

use of computers by the business (available in the data for 1997) had an adverse effect on performance.

The mish-mash of results reinforces our lack of confidence in the specification of the models. With that caveat, the results for training and innovation variables were rarely significant but when they were, the implied impact was that they were associated with inferior firm performance. This occurred for the variable indicating whether or not training had been increased up to 1995, both for profits per employee in 1995, and as a lagged variable for profits per employee in 1996 and profit margins in 1997. Having undertaken research and development (or paid another firm to do so) over the period of the survey was associated with a higher profit margin in 1998, yet having introduced new products or services was associated with a lower profit margin.

Changes in performance

Modelling performance in terms of changes, as opposed to levels, offers promise as it may control for omitted variables affecting profit levels where these are a constant for the firm from one year to the next. Unfortunately, much the same story holds for the range of models tested for changes in performance. Changes in the rate of return on assets, profit margin, profit per employee, sales per employee and total income per employee were tested. Again, all models had very low explanatory power and the sign and magnitude of the estimates are highly unstable with respect to the specification, and thus results are not reported in full. For the sake of completeness, we discuss the variables found to be significant for the change in firm performance from 1996–97 to 1997–98, the final year of the survey, as this provides the incorporation of lags over multiple years and of the maximum training history information (table 18). The intention behind the reporting is not to suggest that these are genuine relationships that have been unearthed, but rather to stress the inconsistencies across the models and the fact that many of the results are counter-intuitive.

As Northwood (1999) found, the inclusion of lagged values of the dependent variable did improve the explanatory power of the models, and these variables are the ones to attain significance most consistently. Even here, past changes are positively correlated with the most recent change in the rate of return on assets, indicating some persistence in improving or deteriorating performance. On all other measures, negative coefficients on past values of the dependent variable suggest a tendency to reverse recent changes. The inclusion of the level of the dependent variable gave weak evidence that there was a tendency for differences in performance to widen rather than narrow over the survey period in some models.

In three models, the implementation of business comparisons was associated with improved performance in the same or following year, while increased labour costs as a proportion of total costs, appeared regularly as a factor preceding a fall in measured performance. The variables of most interest — increases in training or the incidence of training — again fail to feature prominently among the significant results. An increase in the number of employees receiving training was associated with a fall in sales per employee and total income per employee, although these results were only weakly insignificant. Having reported an innovation (-ve) and having undertaken R&D (+ve) over the survey period had opposing effects on changes in the profit margin, a result also observed in the model for the level of the profit margin in 1997–98.

In summary, it remains the case that despite extensive exploration and experimentation with the data, variations in performance between firms and in changes in performance over time and between firms have not been adequately explained here. We can say with some confidence that there is no simple relationship between the training variables and the most obvious candidates for measures of firm performance or changes in firm performance in the BLS data. However, given the inability to adequately identify the major determinants of firm performance, it is also the case that we cannot reject the hypothesis, that training, innovation or some combination of the two are important factors influencing firm performance.

Table 18: Variables attaining significance at the 10% level or higher—models for the change in firm performance from 1996–97 to 1997–98

Dependent variable	Negative coefficients	Positive coefficients
Change in rate of return on assets	Δ Wages/costs (t) Δ Liabilities/assets ratio (t) Δ Liabilities/assets ratio (t-2)	Dependent var (t-1) Dependent var (t-2) Implemented awards (t) Δ Wages/costs (t-1)
Change in profit margin	Dependent var (t-1) Undertook R&D (96–98) Δ Capital/employee (t-1)	Implementing bus. comparisons (t) Innovation (1995–98)
Change in profit per employee	Dependent var (t-1) Dependent var (t-2) Imp. individual agreements (t-1) Δ Capital/employee (t-3)	Δ Total employment (t-1) Δ Capital/employee (t-2)
Change in sales per employee	Dependent var (t-1) Δ Total employment (t-1) Δ Total employment (t-2) Δ Prop in union (t-1) ↑ Number in training (t) Δ Wages/costs (t) Δ Wages/costs (t-1)	Implemented awards (t-1) Implemented awards (t-2) Implemented. indiv. agmt (t-1) Implemented bus. comparisons (t-1) Δ Capital/employee (t-2)
Change in total income per employee	Dependent var (t-1) Dependent var (t-2) Δ Total employment (t) Δ Total employment (t-1) Family business ↑ Number in training (t) Δ Capital/employee (t-1) Δ Capital/employee (t-2) Δ Wages/costs (t) Δ Wages/costs (t-1)	Implemented bus. comparisons (t-1) Δ Capital/employee (t)

Notes: Δ denotes 'change in'; ↑ denotes 'increase in'.

Summary and conclusions

This paper utilises data from the Australian Bureau of Statistics' Business Longitudinal Survey to explore relationships between training, innovation and firm performance for Australian businesses with less than 200 employees. There is a wide body of literature that has endeavoured to demonstrate that training generates positive returns to employers by means of improved productivity. The growing weight of evidence does suggest that firms can, and do gain by increasing or refining their training efforts. However, no single research design or set of studies has been able to demonstrate definitively and positively, the extent and nature of these benefits, due to difficulties in the measurement of training, issues of selectivity and the potentially diverse range of paths and time horizons over which the effects of training may be transmitted. Much of the impetus behind this study lies in the common assertion that recent economic developments have meant that the ability of a firm (and its workforce) to innovate and to adapt is becoming an increasingly critical source of competitiveness, and that training has an important role in fostering these capabilities.

The most common form of training provided by the firms within the sample was on-the-job training, with around 30% of employees in the average firm receiving this training in the final year of the survey compared to less than 15% of employees receiving structured training. The training data available in the survey confirms existing evidence of a strong, positive correlation between firm size and training provision. This can be seen clearly in simple bivariate statistics and in more sophisticated models controlling for a wider range of factors. Correlations between training variables show that changes to training within businesses have a tendency to be implemented across the different types of training simultaneously. This and other relationships identified throughout the analysis strongly suggest that different types of training—such as technical, on-the-job, structured and managerial training—are not substitutes, but complements and are suggestive of the existence of 'high-training' and 'low-training' cultures across firms. There is a much smaller but still significant relationship whereby firms implementing training changes are likely to undergo further similar changes in the following years. This may reflect either the fact that the implementation of changes occurs over a period of a number of years, or again that it is a particular characteristic of certain firms to regularly implement such changes.

Apart from firm size, industry effects are also strong for structured training, but weaker for on-the-job training. Other expected results arise with reference to the level of training provided. Higher levels of part-time or casual employment are associated with a lower incidence of training, while higher-paying firms also provide more training. Looking at reported changes in training, the longitudinal nature of the data allows relationships between future and historical values of variables to be tested in an attempt to differentiate a more persistent firm culture from the one-off impact of reforms. There is strong evidence that training often occurs in tandem with other business changes. It seems clear then that training is used as one of the major tools by which the implementation of new technology, practices and strategies are facilitated. Only limited associations between past and future business changes and training are uncovered. Hence the evidence that training is a causal factor in bringing about change is weak. The same holds for more specific measures of innovation, defined as the introduction of substantially changed processes, products or services. A heightened training effort tends to accompany innovations, but not in itself to induce innovation.

Analysis of the determinants of which firms were more likely to report an innovation reveals a 'large firm', effect consistent with an extensive economic literature that argues that larger firms (or efficient networks) offer synergies in innovation and in research and development. As with training, innovation increases with firm size, but at a declining rate, such that a given difference in the number of employees has a considerable effect for smaller firms, but less of an effect for large firms. There is a strong correlation between innovation and undertaking research and development activities, however stark contrasts between the effects of different factors on innovation and R&D measures suggests that R&D-based variables may be very poor proxies for innovation, despite their common use for that purpose. As an example, we find the mining industry to be a very low innovator but to be very active in research and development.

Strong evidence appears of changes in training being associated with the occurrence of innovations over the period of the survey, and to a minor extent, of a link between innovation and the level of on-the-job training being provided in the final year of the survey. We could not, however, claim to have found support to sustain a claim that training in itself brings about innovation. Perhaps the strongest evidence for this comes through the finding that firms which undertake formal business or strategic planning are both higher trainers and high innovators. Moreover, increases in management training were found in several models to precede the implementation of business planning. This is consistent with management training providing mangers with the capacity to implement formal planning processes, which in turn appears to promote innovation. The existence of a differential relationship between training and innovation for 'efficient' and 'inefficient' firms, as has been found in previous studies, was not supported by the analysis.

Evidence of a more specific nature is provided when the take-up of internet-related activities is used as an applied example to analyse the role of training in innovation. Adoption rates of this new technology are again clearly higher for large firms, for businesses with formal planning procedures and for those paying higher wages. Evidence is found of a link between increases in management training and the adoption of e-commerce. More importantly, all three indicators of the take-up of internet-related activities were positively associated with the level of structured training provided in the following year, again suggestive of a high level of formal training being a component of an innovative firm culture.

Thus there is limited evidence of synergies existing between training and innovation. We can say with confidence that training is an important tool in the implementation of innovations and other business changes. However, with the exception of those few examples noted, the lack of relationships between past business changes and current training activity, or of training activity and future business changes, is not supportive of the view that training in itself is a primal source of innovation. Attempts to further relate training and innovation variables to business performance outcomes have been even less successful. This may partially reflect that there are long lead-times to the pay-offs for training and innovation. Before any claims can be made in this regard, considerable improvements in the modelling of firm performance using the BLS data will need to be achieved, particularly with respect to the specification of models, treatment of outliers and the appropriate use of weights. A potential avenue is to merge the BLS data with secondary data, such as data on aggregate industry growth, industry concentration or import penetration.

The research has produced some valuable results, but has also served to re-emphasise the many problems that have confounded economists in attempting to analyse the benefits and impacts of training. Issues of the measurement of training have previously been noted, including a tendency for employers to overestimate training levels. In this data there is clearly a question mark over the interpretation of 'increases in training'. Important information is also missing from this data set, particularly the extent to which firms may have 'purchased' training from outside by way of hiring skilled labour as an alternative to providing training themselves. The findings here suggest that the focus of the research agenda perhaps needs to shift away from viewing training as just a general input, to one that is purpose-specific. This would change the evaluation criteria considerably, and also enable more exacting research

designs. As an example, take two firms looking to update their production technology. The firm providing greater training may achieve this more cost-effectively than the 'counterfactual' firm that does not provide extra training, yet standard measures of performance may well deteriorate during the implementation period.

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Appendix tables

Table A1: Probit estimates of the proportion of employees receiving training[1]—structured and on-the-job training, 1997–98

	Structured training		On-the-job training	
	(1)	(2)	(3)	(4)
Intercept	-3.1964***	-3.8598***	-1.9967***	-2.4339***
Prop receiving				
on-the-job training		0.2738***		
structured training				0.3564***
Total employment	0.0168***	0.0147***	0.0122***	0.0088***
Employment squared	-0.0001***	-0.0001***	-0.0001***	-0.0001***
% part-time	-0.1614**	-0.1249	-0.2762***	-0.2694***
% casual	-0.0021**	-0.0036***	0.0046***	0.0054***
% female	0.0008	0.0003	0.0013*	0.0011
% labour turnover			0.0004*	0.0005**
Age of business	0.0059	0.0108***	-0.0130***	-0.0148***
Industry				
Mining	0.2883*	0.2918*	0.0173	-0.1120
Manufacturing	–	–	–	–
Construction	0.2878***	0.2751***	0.0812	-0.0002
Wholesale	0.1851***	0.1704***	0.0756	0.0379
Retail	0.2938***	0.2963***	0.0071	-0.0706
Accom, cafes, restrnts	0.2467**	0.2702**	-0.0918	-0.1716*
Transport & storage	0.1733*	0.1836*	-0.0544	-0.1274
Finance and insurance	0.4371***	0.4613***	-0.0513	-0.2062**
Property & bus. services	0.4175***	0.4409***	-0.0549	-0.2021***
Cultural & rec. services	-0.2261	-0.0454	-0.5314***	-0.5163***
Personal & other services	0.4131***	0.3867***	0.1404	0.0164
Family business	-0.1842***	-0.1827***	-0.0666*	-0.0172
Prop union members	0.0348*	0.0406**	-0.0070	-0.0145
Most employees				
On award	0.3288***	0.2492***	0.4507***	0.4158***
Individual agreement	0.3058***	0.2355***	0.3693***	0.3125***
Ent. agmt. (registered)	0.4665***	0.4159***	0.3261***	0.2185***
Ent. agmt. (non-reg)	0.2364***	0.1648**	0.3108***	0.2842***
Other	–	–	–	–
Formal strategic/bus plan	0.2781***	0.2066***	0.2635***	0.1917***
Makes comparisons with other businesses	0.3018***	0.2594***	0.1812***	0.0998**
Increase 1997–98 in:				
No. of staff using computers	0.1328***	0.0921**	0.1411***	0.1248***
Range of product/servcs			0.1374***	0.1343***
Distribution	-0.0759	-0.0966*		
Targetting export markets			0.1074**	0.1222**
Production technology	0.1097**	0.0723	0.1369***	0.1099**
Admin computer systems	0.2739***	0.2451***	0.1383***	0.0718

	Structured training		On-the-job training	
	(1)	(2)	(3)	(4)
Intends to				
Increase production	0.1033**	0.0735*	0.1094***	0.0924**
Introduce new goods/serv	0.0683	0.0532	0.0635	0.0491
Sell the whole business	-0.0968	-0.1377*	0.1315*	0.1628**
Close the business	-0.4983***	-0.4780***	-0.4378***	-0.3746***
Begin or increase exports			0.0983*	0.1154**
Performed or paid for R&D	0.1123*	0.1063*		
Expend on R&D/emp ($'000)			-0.0078***	-0.0067**
Value of exports/emp ($'000)	-0.0002***	-0.0001*	-0.0003***	-0.0002***
Total income per emp ($m)	0.0700**	0.0476	0.0604**	0.0553**
Profits per employee ($'000)	-0.0001**	-0.0001*		
Wages per employee ($'000)	0.0034***	0.0031***	0.0017*	0.0009
Wage share of total costs	0.1957*	0.1454	0.3112***	0.3133***
Intercept 2	0.3098	0.3392	0.3655	0.3850
Intercept 3	0.7542	0.8244	0.8063	0.8531
Intercept 4	1.8736	2.0136	1.6063	1.6996
Observations	4328	4328	4331	4331
Log likelihood	-4357	-4163	-6125	-5928

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively, by chi-square test; 1. Dependent variables are polychomotous response variables coded 1 = 'none', 2 = 'up to 25%', 3 = '26% to 50%', 4 = '51% to 75%, 5 = '76% to 100%'.

Table A2: Logit estimates of the likelihood of a business reporting major increase in technical and management training, 1994–95

	Current variables only		Current and retrospective		Current and future vars	
	Technical	Mgmt	Technical	Mgmt	Technical	Mgmt
Intercept	-3.5226***	-3.8219***	-3.4139***	-3.7174***	-3.3860***	-3.8145***
Total employment	0.0134***	0.0208***	0.0147***	0.0219***	0.0123***	0.0186***
Employment squared	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001**	-0.0001***
Δ tot emp (t)			-0.0001	-0.0003		
— (t+1)					0.0001	0.0004
% part-time	-0.3606**	-0.0041	-0.3318**	-0.0016	-0.5231**	-0.0345
Δ % part-time (t)			0.2470	-0.3362		
— (t+1)					-0.4192	-0.1695
Age of business	0.0020	0.0054	-0.0057	-0.0052	-0.0008	0.0176*
Family business	-0.2428***	-0.0805	-0.2611***	-0.0759	-0.3192***	-0.1017
Industry						
Mining	0.9434***	1.0152***	0.9375**	1.1642***	0.8896**	1.1916***
Manufacturing	–	–	–	–	–	–
Construction	0.7417***	0.4062**	0.8172***	0.4470***	0.8450***	0.3308
Wholesale	0.4781***	0.2844***	0.4845***	0.3063***	0.3274**	0.1226
Retail	0.6605***	0.6704***	0.6258***	0.6450***	0.6368***	0.5939***
Accom, cafes, restrnts.	-0.0761	-0.0650	-0.1961	-0.1348	-0.0935	0.0079
Trans & storage	0.3321*	0.4648***	0.3472*	0.4741**	0.2822	0.4520*
Fin & insurance	0.8405***	0.7759***	0.8380***	0.7596***	0.7664***	0.4787*
Property & BS	0.4998***	0.5051***	0.4707***	0.4414***	0.2923**	0.2028
Cultural & rec.	-0.3833	-0.1980	-0.5433*	-0.3387	-0.2742	-0.1022
Personal etc	1.2603***	0.6374***	1.3692***	0.7398***	1.3046***	0.8564***
Opened locations (t)	0.0314	-0.0109	0.1174	0.0791	0.1048	0.1885
— (t+1)					0.1830	0.3417*
Prop. in union (t)	0.0064	0.0103	0.0097	0.0083	0.0244	0.0053
Δ prop in union (t+1)					0.0150	-0.0665
Has employees:						
On award	0.0707	0.0828	0.0443	0.0374	-0.0313	-0.1295
Indiv. agm't.	0.1682**	0.0389	0.1529*	0.0329	0.0563	-0.0990
Ent. agm't (reg)	-0.0180	0.3243**	-0.0459	0.3454**	-0.1514	0.1491
—(non-reg)	0.1378	0.2423	0.1330	0.2234	0.3416*	0.1277
Implemented:						
Award (t+1)					0.0720	-0.0739
Indiv agm't (t+1)					-0.2169	-0.1947
Ent. agm't. (non-reg) (t+1)					-0.1395	-0.1426
Ent. agm't. (reg) (t+1)					-0.5725*	-0.1423
Increase in:						
Range product/servcs (t)	0.2988***	0.2236***	0.2562***	0.2015**	0.3510***	0.2165**
— (t+1)					-0.0406	-0.0275
Advertising (t)	0.2672***	0.4604***	0.2662***	0.4560***	0.2136**	0.4471***
— (t+1)					0.2094*	0.1649
Distribution (t)	-0.2000**	-0.1667*	-0.1974**	-0.1954**	-0.0923	0.0423
— (t+1)					-0.1454	-0.0379
Target domestic mkts (t+1)					-0.2687**	-0.2210*
Market targetting (t)	0.4714***	0.3428***	0.4720***	0.2995***	0.5868***	0.2925***
Admin computer Systems (t)	0.9644***	1.1603***	0.9163***	1.1575***	0.8256***	1.1061***
Prod technology (t)	1.8489***	0.9117***	1.8322***	0.8497***	1.7289***	0.9678***
— (t+1)					0.2748**	0.1657

	Current variables only		Current and retrospective		Current and future vars	
	Technical	Mgmt	Technical	Mgmt	Technical	Mgmt
Target export mkts (t+1)					0.0462	-0.0675
Acct software (t+1)					0.1706	0.1434
Oth admin syst (t+1)					0.0133	0.0647
Δ bus structure (t+1)					-0.2356	-0.0306
Other change (t)	0.3003*	0.6338***	0.2343	0.6109***	0.2499	0.8042***
— (t+1)					0.0030	-0.5192
Intends to:						
Increase prod	0.1432**	0.0762	0.1193	0.1198	0.0446	-0.0437
Decrease prod	0.0106	0.4350**	-0.0487	0.3554*	-0.0577	0.2868
Open new locations	0.0270	0.2363***	0.0098	0.2033**	-0.0438	0.1212
Sell the business	-0.1556	-0.0595	-0.1402	-0.0814	-0.1275	0.1167
Close the business	-0.3872**	0.0118	-0.3741*	0.0097	-0.4460	0.3173
Has business plan (t)	0.4094***	0.6683***	0.3936***	0.6644***	0.4259***	0.8191***
Implemented plan (t+1)					0.1420	0.4760***
Makes bus. comparisons	0.3017***	0.4038***	0.3060***	0.4420***	0.3179***	0.4283***
Implemented comparsns (t+1)					0.2428*	0.2758**
Innovation (t)	0.1970**	0.0792	0.2088**	0.0952	0.1516	0.0884
— (t+1)					0.1029	0.0032
Value exports/emp (t)	-0.0001	-0.0001	-0.0002	-0.0003	-0.0001	-0.0001
Δ Value expts/emp (t)			0.0002	0.0005		
— (t+1)					3.2×10^{-5}	2.0×10^{-5}
Profit/employee	2.3×10^{-5}	-0.0001	2.6×10^{-5}	-0.0002	1.8×10^{-5}	-0.0004
Δ Profit/emp (t+1)					-2×10^{-6}	-0.0002
Wages/employee	0.0042***	0.0018	0.0046***	0.0020	0.0065**	0.0029
Δ Wages/emp (t+1)					-0.0006	-0.0021
Wages/total costs	0.7728***	0.2002	0.8728***	0.4136**	0.9249***	0.2195
Δ Wages/costs (t+1)					0.8918**	-0.0430
Observations	8205	8205	7045	7045	4470	4470
-2 log likelihood	2796***	2134***	2386***	1837***	1626***	1294***
Deg. of freedom	40	40	43	43	65	65
Concordant	85.3%	83.3%	84.8%	82.9%	84.9%	83.4%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A3a: Logit estimates of the likelihood of a business reporting major increase in on-the-job, management and other training, 1995–96

	Current Variables only		
	On-the-job	Management	Other training
Intercept	-3.1081***	-3.6920***	-3.5820***
Total employment	0.0047	0.0119***	0.0040
Employment squared	$-0.2x10^{-3}$	-0.0001**	$4.6x10^{-6}$
% part-time	-0.0104	0.0195	0.0967
Age of business	-0.0101	-0.0113	-0.0017
Family business	-0.0381	-0.0835	-0.1273
Industry			
Mining	0.6230	0.7256*	0.1220
Manufacturing	—	—	—
Construction	0.0576	0.3033	0.4514**
Wholesale	0.1960	0.2043	0.2063
Retail	0.1704	0.2751	0.2567
Accom, cafes, restrnts.	0.2263	0.6465***	0.0531
Trans & storage	0.2016	-0.0246	0.2191
Fin & insurance	0.0482	0.0164	0.2798
Property & BS	-0.0920	-0.2122	0.1644
Cultural & rec.	0.0710	-0.1596	0.2461
Personal etc	0.5621**	0.3209	0.7641***
Opened locations (t)	0.0732	0.3254*	0.2003
Prop in union (t)	0.0458	-0.0123	0.0024
Most employees on:			
Award	0.5227***	0.3491**	0.2201*
Indiv agmt.	0.1258	0.2196	0.1000
Ent. agmt. (reg)	0.6206***	0.6961***	0.2691
- (non-reg)	0.3204**	0.4034	0.2665
Increase in:			
Range product/servcs (t)	0.4220***	0.0578	0.0911
Advertising (t)	0.2484**	0.4132***	0.2262**
Distribution (t)	0.0000	-0.0802	0.0223
Target domestic mkts (t)	0.3304***	0.0994	0.1414
Prod technology (t)	1.0132***	1.1224***	0.7739***
Target export mkts (t)	-0.0523	0.0732	0.1142
Acct. software (t)	0.2898***	0.3474***	0.2715**
Oth admin syst (t)	0.6457***	0.7857***	0.8322***
Δ bus structure (t)	0.4057***	0.6684***	0.3574**
Other change (t)	-0.1826	-0.4116	0.1078
Intends to:			
Increase production (t)	0.4011***	0.5522***	0.3608***
Decrease production (t)	-0.2879	-0.0190	-0.0345
Open new locations (t)	0.2176**	-0.0514	0.2141*
Sell the business (t)	0.1091	-0.3294*	-0.0973
Close the business (t)	-0.4812*	-0.1717	-0.5126
Has business plan (t)	0.4503***	0.5658***	0.5917***
Makes bus. comparisons (t)	0.2693***	0.4073***	0.1971**
Innovation (t)	0.3656***	0.1643	0.4803***
Value exports/emp (t)	-0.0001	-0.0001	-0.0002
Profit/employee (t)	$2.1x10^{-5}$	-0.0001	0.0003**
Wages/employee (t)	-0.0048*	-0.0047	-0.0055*
Wages/total costs (t)	0.6403***	0.2920	0.5918**
Observations	4970	4970	4970
-2 log likelihood	1209***	1067***	860***
Deg. of freedom	43	43	43
Concordant	82.1%	83.9%	81.3%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A3b: Logit estimates of the likelihood of a business reporting major increase in on-the-job, management and other training, 1995–96

	Current and historical variables		
	On-the-job	Management	Other training
Intercept	-3.1769***	-3.8576***	-3.6232***
Total employment	0.0021	0.0125***	0.0019
Employment squared	$8.1x10^{-7}$	-0.0001**	$2.3x10^{-5}$
Δ tot emp (t)	0.0015*	0.0011	0.0017*
% part-time	0.0880	0.1353	0.0815
Δ % part-time (t)	-0.3449	-0.4116	-0.3129
Age of business	-0.0072	-0.0075	-0.0041
Family business	-0.0388	-0.1483	-0.1078
Industry			
Mining	0.6090	0.6902	0.1860
Manufacturing	–	–	–
Construction	-0.1364	0.1785	0.4459*
Wholesale	0.1515	0.1295	0.1685
Retail	0.0461	0.1610	0.1299
Accom, cafes, restrnts	-0.1346	0.3750	-0.2438
Trans & storage	-0.0140	-0.1679	-0.0022
Fin & insurance	0.0839	-0.0675	0.2489
Property & BS	-0.1980	-0.3379*	0.0763
Cultural & rec.	-0.1033	-0.0700	0.1212
Personal etc	0.5823**	0.3959	0.9349***
Opened locations (t-1)	-0.1960	-0.0527	0.2144
— (t)	0.1745	0.3788**	0.2697
Prop in union (t)	0.0394	-0.0544	0.0160
Δ Prop in union (t)	0.0663	0.1451**	-0.0162
Has employees:			
On award	0.6172***	0.4589***	0.2738*
Indiv. agmt.	0.1040	0.1751	0.0591
Ent. agmt. (reg)	0.6839**	0.8645***	-0.0587
—(non-reg)	0.4156	0.2887	-0.0701
Implemented:			
Award (t)	-0.3259**	-0.0888	-0.1561
Indiv agmt. (t)	-0.0328	0.3366	-0.2742
Ent. agmt. (reg) (t)	-0.0670	-0.0754	0.6043
Ent. agmt. (non-reg) (t)	-0.0770	-0.2311	0.3512
Increase in:			
Range P&S (t-1)	0.0458	0.1251	-0.0842
— (t)	0.3950***	0.0904	0.0645
Advertising (t-1)	0.0327	-0.0069	-0.0106
— (t)	0.2753**	0.4241***	0.2610**
Distribution (t-1)	-0.1402	-0.2594*	-0.4372***
— (t)	-0.0524	-0.0172	0.0487
Target domestic mkts (t)	0.2864***	0.0136	0.1317
Mkt targetting (t-1)	0.0375	0.0767	0.0805
Admin computer Systems (t-1)	0.2021**	0.2628**	0.2457**
Prod technology (t-1)	0.1125	0.0644	0.0856
— (t)	1.0384***	1.1260***	0.7502***
Target export mkts (t)	-0.0292	0.0621	0.1061
Acct software (t)	0.3209***	0.3474***	0.2745**
Oth admin syst (t)	0.5842***	0.6832***	0.7776***
Δ bus structure (t)	0.4735***	0.7610***	0.4959***

	Current and historical variables		
	On-the-job	Management	Other training
Other change (t-1)	0.1251	0.3551	0.2501
— (t)	-0.2364	-0.5071	-0.1196
Intends to:			
Increase prod. (t-1)	0.0603	0.0450	0.0288
— (t)	0.4476***	0.5442***	0.3527***
Decrease prod. (t-1)	-0.1864	0.4860	0.2514
— (t)	-0.1282	-0.0444	-0.1305
Open new locations (t-1)	0.0045	0.0302	-0.1539
— (t)	0.2159*	-0.0388	0.2860**
Sell the business (t-1)	0.0778	0.1766	-0.0299
— (t)	0.0792	-0.3636*	-0.0710
Close the business (t-1)	-0.6691	-0.8706	-0.3146
— (t)	-0.3541	0.1161	-0.2823
Has business plan (t)	0.5005***	0.5843***	0.7415***
Implemented plan (t)	0.0184	-0.0960	-0.3012**
Makes bus. comparisons (t)	0.2401**	0.2924**	0.1738
Implemented comparisons (t)	0.0001	0.0751	-0.0763
Innovation (t-1)	-0.3852***	-0.2110*	0.0357
— (t)	0.4601***	0.1590	0.4941***
Value exports/emp (t)	-0.0001	-0.0001	-0.0003
Δ Value expts/emp (t)	4.1×10^{-5}	1.1×10^{-6}	-0.0001
Profit/employee (t)	-0.0001	-2.0×10^{-5}	0.0005***
Δ Profit/emp (t)	0.0008	0.0001	-0.0002
Wages/employee (t)	-0.0046	-0.0026	-0.0052
Δ Wages/emp (t)	0.0009	-0.0025	0.0014
Wages/total costs (t)	0.5840*	0.3968	0.5225
Δ Wages/costs (t)	-0.2462	-0.3803	-0.4179
Observations	4470	4470	4470
-2 log likelihood	1155***	976***	816***
Deg of freedom	70	70	70
Concordant	82.8%	84.3%	82.0%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A3c: Logit estimates of the likelihood of a business reporting major increase in on-the-job, management and other training, 1995–96

	Current and future variables		
	On-the-job	Management	Other training
Intercept	-3.1142***	-3.7689***	-3.5186***
Total employment	0.0041	0.0104***	0.0023
Employment squared	-2.0x10^{-5}	-0.0001*	1.0x10^{-5}
Δ tot emp (t+1)	-0.0001	-0.0017	-0.0013
% part-time	-0.0466	0.0442	0.0257
Δ % part-time (t+1)	-0.1176	0.1757	-0.1072
Age of business	-0.0091	-0.0106	0.0001
Family business	-0.0727	-0.1479	-0.1921*
Industry			
Mining	0.5661	0.4506	0.1050
Manufacturing	–	–	–
Construction	0.1097	0.3415	0.4625**
Wholesale	0.2213*	0.3092**	0.2152
Retail	0.2280	0.3561*	0.2790
Accom, cafes, restrnts	0.2900	0.6928***	0.0977
Trans & storage	0.2558	0.0698	0.3120
Fin & insurance	-0.0509	0.0290	0.2347
Property & BS	-0.0862	-0.2716	0.1064
Cultural & rec.	0.1102	-0.2505	0.1619
Personal etc	0.6098**	0.3136	0.8196***
Opened locations (t)	0.0182	0.3679**	0.2033
— (t+1)	-0.0829	-0.0238	0.0200
Prop in union (t)	0.0520	-0.0134	0.0032
Δ Prop in union (t+1)	0.0242	0.0044	0.1065
Most employees on:			
Award	0.4189***	0.2614*	0.1100
Indiv agm't	-0.0161	0.0764	-0.0077
Ent. agm't (reg)	0.5522**	0.6423***	0.1558
—(non-reg)	0.1889	0.0241	0.1445
Implemented:			
Award (t+1)	0.0168	-0.3008	-0.2592
Indiv agmt. (t+1)	0.0280	0.0793	0.0138
Ent. agmt. (reg) (t+1)	0.3008	0.1616	0.4996*
Ent. Agmt. (non-reg) (t+1)	-0.0146	0.2026	0.2254
Increase in:			
Range P&S (t)	0.3571***	0.0035	0.0663
— (t+1)	0.1809	0.1652	0.0756
Advertising (t)	0.2087*	0.3996***	0.1717
— (t+1)	0.2037	0.0598	0.1461
Distribution (t)	0.0955	0.0758	0.0950
— (t+1)	-0.2878*	-0.4073**	-0.1770
Target domestic mkts (t)	0.2447**	0.0159	0.0158
— (t+1)	0.1183	0.2241	0.1778
Prod technology (t)	0.9809***	1.0368***	0.7439***
— (t+1)	0.2709**	0.2778**	0.1617
Target export mkts (t)	0.0279	0.0125	0.1784
— (t+1)	-0.2535	0.0483	-0.1175
Acct software (t)	0.2512**	0.3492***	0.2411**
— (t+1)	-0.0173	-0.0350	0.0684
Oth admin syst (t)	0.6272***	0.8145***	0.7960***
— (t+1)	0.2396**	-0.0237	0.2000

	Current and future variables		
	On-the-job	Management	Other training
Δ bus structure (t)	0.3331**	0.7289***	0.2853*
— (t+1)	-0.2263	-0.0024	-0.1756
Other change (t)	-0.1832	-0.5712	0.0304
— (t+1)	-0.1021	-0.5025	0.1261
Intends to:			
Increase prod (t)	0.3970***	0.5467***	0.3406***
Decrease prod (t)	-0.0705	0.0041	-0.0655
Open new locations (t)	0.2307*	-0.0478	0.2109*
Sell the business (t)	0.1472	-0.2951	-0.0666
Close the business (t)	-0.4170	-0.2079	-0.3323
Has business plan (t)	0.4909***	0.6354***	0.5897***
Implemented plan (t+1)	0.2182	0.5333***	0.0357
Makes bus. comparisons	0.3102***	0.5006***	0.2740**
Implemeted comparsions (t+1)	0.2661*	0.4163**	0.4299***
Innovation (t)	0.3106***	0.0879	0.4033***
— (t+1)	0.0736	0.1397	0.1677
Implemented R&D (t+1)	-0.2416	-0.1167	0.0440
Value exports/emp (t)	-0.0001	-0.0001	-0.0003
Δ Value expts/emp (t+1)	-0.0002	0.0006*	-0.0002
Profit/employee (t)	5.7x10	-0.0002	0.0004
Δ Profit/emp (t+1)	-0.0002	-0.0001	0.0001
Wages/employee	-0.0052	-0.0066*	-0.0065*
Δ Wages/emp (t+1)	0.0005	-0.0014	-0.0013
Wages/total costs	0.7316***	0.6136*	0.6482**
Δ Wages/costs (t+1)	0.5934	0.6572	0.0259
Observations	4559	4559	4559
-2 log likelihood	1126***	1029***	816***
Deg of freedom	69	69	69
Concordant	81.7%	84.0%	81.1%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A4a: Logit estimates of the likelihood of a business reporting major increase in on-the-job, management and other training, 1996–97

	Current variables only		
	On-the-job	Management	Other training
Intercept	-3.3933***	-4.3847***	-4.1814***
Total employment	0.0081**	0.0123***	0.0157***
Employment squared	-4.0x10^{-5}*	-0.0001*	-0.0001***
% part-time	-0.2200	-0.1853	-0.3458
Age of business	-0.0172*	-0.0201*	-0.0395***
Family business	0.0625	0.1529	0.0299
Industry			
Mining	-0.3472	-0.2880	0.7170
Manufacturing	–	–	–
Construction	0.3571*	0.4781*	0.8242***
Wholesale	-0.2861*	-0.0181	0.1759
Retail	-0.0141	0.4349**	0.5490***
Accom, cafes, restrnts.	0.2967	0.8096***	0.8744***
Trans & storage	0.6501***	0.6256**	0.6325**
Fin & insurance	0.1995	0.6150**	0.8362***
Property & BS	-0.0862	-0.2716	0.1064**
Cultural & rec.	0.2204	0.2473	0.1520
Personal etc	0.3689	0.3515	0.1254
Opened locations (t)	0.1279	0.1333	0.2690
Prop in union (t)	0.0262	0.0487	0.0969**
Most employees on:			
Award	0.6401***	0.4948***	0.3826**
Indiv agmt.	0.2602*	0.2992*	0.1461
Ent. agmt. (reg)	0.8022***	0.6459***	0.5209**
—non-reg)	0.7470***	0.5840***	0.5058**
Increase in:			
Range P&S (t)	0.0227	0.1963	-0.0502
Advertising (t)	0.4128***	0.5791***	0.5925***
Distribution (t)	-0.0361	-0.3456**	-0.1217
Target domestic mkts (t)	0.7385***	0.4269***	0.5058***
Prod technology (t)	1.2464***	1.2390***	1.0490***
Target export mkts (t)	0.0227	0.1912	0.0928
Acct software (t)	0.5434***	0.5113***	0.4504***
Oth admin syst (t)	0.7059***	0.7780***	0.7995***
Δ bus structure (t)	0.2668	0.3083*	0.3578**
Other change (t)	0.4406	-0.4166	0.5620*
Intends to:			
Increase prod (t)	0.4778***	0.4566***	0.4223***
Decrease prod (t)	0.0152	-0.1381	-0.0698
Open new locations (t)	-0.2113	-0.1343	-0.0554
Sell the business (t)	-0.2981	-0.6529**	-0.0797
Close the business (t)	-0.1989	0.0145	-0.0161
Start/incrse exports (t)	-0.1928	-0.0134	-0.1109
Has business plan (t)	0.6093***	0.7491***	0.4420***
Makes bus. comparisons (t)	0.2698***	0.2519**	0.1979*
Innovation (t)	0.3682***	0.3418***	0.4885***
Value exports/emp (t)	-4.0x10^{-5}	-3.5x10^{-5}	-0.0001
Profit/employee (t)	-0.0001	-0.0001	-0.0001
Wages/employee (t)	-0.0029	0.0007	-0.0023
Wages/total costs (t)	-0.0375	-0.4876	-0.2363

	Current variables only		
	On-the-job	Management	Other training
Observations	4955	4955	4955
-2 log likelihood	1187***	968***	834***
Deg of freedom	44	44	44
Concordant	84.1%	85.6%	84.0%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A4b: Logit estimates of the likelihood of a business reporting major increase in on-the-job, management and other training, 1996–97

	Current and historical variables		
	On-the-job	Management	Other training
Intercept	-3.7201***	-4.2889***	-4.1763***
Total employment	0.0079*	0.0084*	0.0132***
Employment squared	-4.0x10^{-5}	-3.0x10^{-5}	-0.0001*
Δ tot emp (t)	0.0033***	0.0017	0.0017
% part-time	-0.3884	-0.2812	-0.2658
Δ % part-time (t)	-0.2351	0.1095	0.1686
Age of business	-0.0139	-0.0240*	-0.0446***
Family business	0.0906	0.1091	0.0138
Industry			
Mining	-0.2826	0.1914	0.9271*
Manufacturing	–	–	–
Construction	0.2742	0.6660**	0.8931***
Wholesale	-0.0827	0.0127	0.2554
Retail	0.0600	0.5490**	0.5130**
Accom, cafes, restrnts	0.3478	0.7122**	0.6282*
Trans & storage	0.8562***	0.7769**	0.5359
Fin & insurance	0.2881	0.9977***	0.9279***
Property & BS	0.0147	0.3140	0.3828*
Cultural & rec.	0.2506	0.1182	-0.3260
Personal etc	0.0368	0.6973	0.0135
Opened locations (t-1)	0.1687	0.5108**	0.3187
— (t)	0.1314	0.1907	0.2524
Prop in union (t)	0.0318	0.0487	0.1031**
Δ Prop in union (t)	-0.0624	0.0754	0.0657
Has employees:			
On award	0.7002***	0.6446***	0.4181**
Indiv agmt.	0.2471	0.4007*	0.1919
Ent agmt. (reg)	1.0529***	1.0982***	0.7922***
—(non-reg)	0.9154***	0.8385**	0.5898
Implemented:			
Award (t)	0.1146	-0.2148	-0.1770
Indiv agmt (t)	0.2842	-0.0337	0.0289
Ent. agmt. (reg) (t)	-0.4289	-0.7299*	-0.7916*
Ent. agmt. (non-reg) (t)	-0.2759	-0.2477	0.0007
Increase in:			
Range P&S (t-1)	-0.0927	-0.1235	-0.2040
— (t)	0.0608	0.1800	0.1548
Advertising (t-1)	-0.1188	0.0657	-0.0067
— (t)	0.4342***	0.6955***	0.5797***
Distribution (t-1)	-0.1988	0.0871	-0.1278
— (t)	-0.0617	-0.4192**	-0.1867
Target domestic mkts (t-1)	-0.0260	-0.2031	-0.1937
— (t)	0.8542***	0.4741***	0.5149***
Prod technology (t-1)	0.4803***	0.3681***	0.3449**
— (t)	1.0794***	1.1356***	0.9021***
Target export mkts (t-1)	0.0388	0.0660	-0.1975
— (t)	-0.0600	0.1538	0.1878
Acct software (t-1)	-0.0782	0.0836	-0.0581
— (t)	0.5739***	0.5568***	0.3459**

	Current and historical variables		
	On-the-job	Management	Other training
Oth admin syst (t-1)	0.2206*	0.0957	0.1287
— (t)	0.5892***	0.7155***	0.7706***
Δ bus structure (t-1)	0.0157	-0.1766	-0.0218
— (t)	0.3500*	0.4343**	0.2704
Other change (t-1)	1.6808***	0.9889**	0.4374
— (t)	0.4869	-0.9696**	0.4956
Intends to:			
Increase prod (t-1)	0.2703**	0.1721	0.0015
— (t)	0.2957**	0.3458**	0.3814***
Decrease prod (t-1)	-0.3403	-0.9791	-0.1475
— (t)	0.0021	-0.2728	-0.2714
Open new locations (t-1)	-0.2292	-0.4034**	-0.0701
— (t)	-0.2136	-0.1461	-0.0522
Sell the business (t-1)	-0.1156	-0.3363	0.2215
— (t)	-0.2566	-0.4605	-0.0609
Close the business (t-1)	0.2367	-0.0626	-0.7741
— (t)	-0.1250	0.2245	0.3436
Start/incrse exports (t)	-0.1056	-0.0234	0.0470
Has business plan (t)	0.6339***	0.8391***	0.5593***
Implemented plan (t)	-0.0182	-0.1844	-0.2274
Makes bus. comparisons (t)	0.1903	0.1511	0.0044
Implemented comparisons (t)	0.0901	0.0041	0.2510
Innovation (t-1)	0.0615	0.1141	0.4116***
— (t)	0.3813***	0.3578***	0.2996**
Implemented R&D (t)	-0.0926	-0.1141	0.1230
Value exports/emp (t)	-2.0×10^{-5}	-7.3×10^{-6}	-0.0001
Δ Value expts/emp (t)	-2.0×10^{-5}	0.0001	0.0001
Profit/employee (t)	-2.0×10^{-5}	-0.0002	-4.0×10^{-5}
Δ Profit/emp (t)	-0.0002	0.0001	-0.0005
Wages/employee (t)	-0.0067*	-0.0030	-0.0032
Δ Wages/emp (t)	0.0063	0.0028	0.0021
Wages/total costs (t)	0.2654	-0.8252*	-0.3279
Δ Wages/costs (t)	-0.7002	0.8822	-0.3752
Observations	4102	4102	4102
-2 log likelihood	1034***	848***	668***
Deg of freedom	75	75	75
Concordant	85.0%	86.0%	84.4%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A4c: Logit estimates of the likelihood of a business reporting major increase in on-the-job, management and other training, 1996–97

	Current and future variables		
	On-the-job	Management	Other training
Intercept	-3.5182***	-4.5423***	-4.1990***
Total employment	0.0067*	0.0113**	0.0162***
Employment squared	-3.0x10^{-5}	-4.0x10^{-5}	-0.0001***
Δ tot emp (t+1)	0.0005	0.0013*	0.0011
% part-time	-0.2126	-0.0611	-0.3909
Δ % part-time (t+1)	-0.0752	0.2303	-0.0319
Age of business	-0.0190*	-0.0236**	-0.0395***
Family business	0.0713	0.1617	-0.0021
Industry			
Mining	-0.3081	-0.3855	0.8049
Manufacturing	–	–	–
Construction	0.3089	0.4889*	0.8224***
Wholesale	-0.2243	0.0648	0.3024*
Retail	0.0282	0.4882**	0.6396***
Accom, cafes, restrnts	0.2190	0.8252***	0.8486***
Trans & storage	0.5759**	0.6457**	0.5619*
Fin & insurance	0.1757	0.5740*	0.9074***
Property & BS	0.0209	0.2373	0.3892*
Cultural & rec.	0.2327	0.3891	-0.0534
Personal etc	0.4772	0.4688	0.2910
Opened locations (t)	0.1662	0.2348	0.2116
— (t+1)	-0.3369*	-0.3925*	-0.0773
Prop in union (t)	0.0681	0.0547	0.0650
Δ Prop in union (t+1)	0.0669	0.0052	-0.0539
Most employees on:			
Award	0.6393***	0.5405***	0.3841**
Indiv agmt.	0.2457	0.2656	0.1453
Ent. agmt. (reg)	0.7637***	0.5886**	0.5183**
- (non-reg)	0.7463***	0.5947***	0.4926**
Implemented:			
Award (t+1)	0.1067	0.1762	-0.1437
Indiv agmt. (t+1)	-0.1215	-0.3102	-0.2723
Ent. agmt. (reg) (t+1)	0.0773	-0.5813	0.3153
Ent. agmt. (non-reg) (t+1)	0.1753	0.1022	0.2335
Increase in:			
Range P&S (t)	0.0176	0.1774	0.0056
— (t+1)	-0.0314	-0.2668	-0.2637
Advertising (t)	0.3659***	0.5821***	0.5784***
— (t+1)	0.1513	0.0616	0.2529*
Distribution (t)	-0.1192	-0.4007**	-0.2599
— (t+1)	0.1674	0.2265	0.2574
Target domestic mkts (t)	0.7570***	0.4030***	0.5482***
— (t+1)	-0.1470	0.0227	-0.0969
Prod technology (t)	1.2005***	1.1737***	0.9947***
— (t+1)	0.1547	0.2684*	0.2534*
Target export mkts (t)	-0.0495	0.1295	0.1114
— (t+1)	-0.2157	-0.1290	-0.1707
Acct software (t)	0.5186***	0.4901***	0.4493***
— (t+1)	0.0668	0.1902	0.1514
Oth admin syst (t)	0.6818***	0.7355***	0.7421***
— (t+1)	0.0777	-0.0112	0.0133

	Current and future variables		
	On-the-job	Management	Other training
Δ bus structure (t)	0.3088*	0.3847**	0.3918**
— (t+1)	0.0797	0.1820	-0.0886
Other change (t)	0.4184	-0.4587	0.5356*
— (t+1)	0.0980	-0.1551	0.3829
Intends to:			
Increase prod (t)	0.4095***	0.4226***	0.3422***
Decrease prod (t)	0.0642	-0.1913	-0.2581
Open new locations (t)	-0.1769	-0.1083	-0.0655
Sell the business (t)	-0.1942	-0.5107*	-0.0671
Close the business (t)	-0.2244	0.2816	0.3070
Start/increase exports (t)	-0.1186	0.0386	-0.0769
Has business plan (t)	0.6792***	0.7419***	0.4004***
Implemented plan (t+1)	0.3825**	0.2903	0.0314
Makes bus. comparisons	0.2323**	0.2358*	0.1931
Implemented comparisons (t+1)	-0.0312	0.1063	0.1759
Innovation (t)	0.3009***	0.3045**	0.4498***
— (t+1)	0.1825	0.1443	0.1437
Implemented R&D (t+1)	-0.2545	0.3746	0.2532
Value exports/emp (t)	-4.0×10^{-5}	2.9×10^{-5}	-0.0001
Δ Value expts/emp (t+1)	-0.0001	-0.0002	0.0000
Profit/employee (t)	-0.0001	-2.0×10^{-5}	-0.0001
Δ Profit/emp (t+1)	0.0001	-0.0002	0.0003
Wages/employee	-0.0015	0.0021	-0.0046
Δ Wages/emp (t+1)	0.0001	0.0031	-0.0021
Wages/total costs	0.0089	-0.5128	-0.0075*
Δ Wages/costs (t+1)	0.3423	-0.1198	0.9689*
Observations	4521	4521	4521
-2 log likelihood	1092***	915***	788***
Deg of freedom	70	70	70
Concordant	83.7%	85.4%	83.8%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A5: Logit estimates of the likelihood of a business reporting an increase in the number of people being trained, 1997–98

	Current variables only	Current and past variables
Intercept	-1.6027***	-1.4667***
Total employment	0.0068**	0.0064**
Employment squared	-0.0001***	-0.0001***
Δ tot emp (t)		-0.0002
% part-time	-0.1461	-0.0243
Δ % part-time (t)		-0.2148
Age of business	0.0238***	0.0081
Family business	0.0823	0.0579
Industry		
Mining	-0.2632	-0.0780
Manufacturing	—	—
Construction	0.1436	0.0596
Wholesale	0.1409	0.1219
Retail	-0.0011	-0.0099
Accom, cafes, restrnts	-0.2620	-0.3168*
Trans & storage	-0.3460**	-0.3994**
Fin & insurance	-0.4794***	-0.4856**
Property & BS	-0.1278	-0.1544
Cultural & rec.	-0.2233	-0.2054
Personal etc	-0.0966	0.0406
Opened locations (t-1)		0.0343
— (t)	-0.2245*	-0.0298
Prop in union (t)	0.0688**	0.0882**
Δ Prop in union (t)		-0.0310
Has employees:		
On award	1.2870***	1.4160***
Indiv agm't	1.0145***	1.1484***
Ent. agm't (reg)	1.1255***	1.2579***
—(non-reg)	0.9739***	1.2459***
Implemented:		
Award (t)		-0.2903**
Indiv agmt (t)		-0.2082
Ent. agmt. (reg) (t)		-0.0412
Ent. agmt. (non-reg) (t)		-0.3511
Increase in:		
Range P&S (t-1)		-0.0258
— (t)	-0.0785	-0.0340
Advertising (t-1)		0.0026
— (t)	-0.0253	0.0362
Distribution (t-1)		-0.0452
— (t)	-0.2816**	-0.2078
Target domestic mkts (t-1)		0.0590
— (t)	-0.2448**	-0.2617**
Prod technology (t-1)		-0.1150
— (t)	-0.1809*	-0.2254**
Target export mkts (t-1)		-0.0437
— (t)	0.3023***	0.3280***
Acct software (t-1)		-0.0877
— (t)	0.0649	0.1052
Oth admin syst (t-1)		0.1924*
— (t)	0.0218	-0.0683
Δ bus structure (t)	-0.2887**	-0.2741*

	Current variables only	Current and past variables
Other change (t-1)		0.0993
— (t)	-0.2325	-0.1831
Intends to:		
Increase prod (t-1)		-0.1590**
— (t)	0.2569***	0.3029***
Decrease prod (t-1)		-0.0660
— (t)	0.3924*	0.4737**
Open new locations (t-1)		-0.0555
— (t)	-0.1315	-0.0585
Sell the business (t-1)		-0.0553
— (t)	0.3149**	0.3593**
Close the business (t-1)		-0.7182***
— (t)	-0.7004***	-0.6551***
Start/incrse exports (t-1)		-0.0573
— (t)	-0.0008	0.1288
Has business plan (t)	0.4637***	0.5254***
Implemented plan (t)		0.0160
Makes bus. comparisons (t)	0.1653**	0.1232
Implemented comparisons (t)		0.1121
Innovation (t-1)		-0.2580***
— (t)	-0.1138	-0.0467
Implemented R&D (t)		-0.1501
Value exports/emp (t)	-0.0001	-0.0001
Δ Value expts/emp (t)		-0.0001
Profit/employee (t)	-9.3×10^{-5}	0.0001
Δ Profit/employee (t)		-0.0002
Wages/employee (t)	-0.0004	0.0003
Δ Wages/employee (t)		-0.0002
Wages/total costs (t)	0.5216***	0.5725***
Δ Wages/total costs (t)		-0.0790
Observations	5018	4521
-2 log likelihood	675***	695***
Deg of freedom	44	75
Concordant	70.1%	71.4%

Notes: ***, **, * denote variable is significant at the 1%, 5% and 10% level, respectively.

Table A6: Logit estimates of firm Innovation (1994–95 to 1997–98) and R&D activity (1995–96 to 1997–98)

	Reported an innovation	Undertook research and development
Intercept	-1.1560 ***	-3.3868 ***
Total employment	0.0096 **	0.0065
Total employment squared	-0.0001 **	-1.0x10⁻⁵
Age of business	-0.0143	0.0044
Family business	0.1712 *	-0.0295
Industry		
Mining	-1.9712 ***	1.2905 ***
Manufacturing	–	–
Construction	-0.3745 **	-1.2928 ***
Wholesale	0.5007 ***	-1.3826 ***
Retail	-0.0018	-1.1661 ***
Accom, cafes, restrnts	0.4562 **	-1.0156 **
Trans & storage	-0.0455	-1.1432 ***
Fin & insurance	0.0094	-1.2037 ***
Property & BS	-0.1325	-0.8956 ***
Cultural & rec.	0.1217	-0.7525 *
Personal etc	0.2472	-1.5127 ***
Increased:		
Mgt training (94–95 to 96–97)	0.2344 **	-0.0662
Technical training (94–95)	0.5755 ***	0.2327 *
On-the-job training (95–96, 96–97)	0.4217 ***	0.2384 **
Number in training (97–98)	-0.2005 **	-0.1435
% employees recv:		
Structured training (97–98)	0.0365	0.0880
On-the-job training (97–98)	0.1003 ***	0.0441
Undertook/paid for R&D	1.9092 ***	
Recorded innovation		1.8863 ***
Prop in union	-0.0435	0.0404
Most employees on:		
Award	-0.1474	-0.1970
Indiv agmt.	0.0188	0.2922 *
Ent agmt (reg)	-0.3183	0.2740
—(non-reg)	-0.1389	0.1407
Intends to:		
Increase prod	0.6713 ***	-0.1499
Decrease prod	0.4332	-0.6997
Open new locations	0.1747	-0.1201
Close the business	-0.5368 **	
Increase exports	0.3022 *	0.8543 ***
Has business plan	0.3321 ***	0.2596 **
Makes bus. comparisons	0.2763 ***	0.0540
Exporter	0.1103	0.7206 ***
Capital/employee	-0.0007 **	
Wages/employee	-0.0020	0.0057 **
% part-time		-0.2917
Observations	3265	3265
-2 log likelihood	919 ***	940 ***
Deg of freedom	36	35
Concordant	79.0%	85.3%

Table A7: Logit estimates of firm Innovation with firm performance/ training interaction terms

	Performance measure used in training interaction term				
	Return on equity	Return on assets	Profit margin	Profit per employee	Profit to wages ratio
Intercept	-1.1568***	-1.1514***	-1.1581***	-1.1556***	-1.1549***
Total employment	0.0094**	0.0101**	0.0096**	0.0094**	0.0091**
Total employment squared	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**
Age of business	-0.0144	-0.0147	-0.0139	-0.0138	-0.0143
Family business	0.1716*	0.1747**	0.1715*	0.1693*	0.1709*
Industry					
Mining	-2.0051***	-1.9688***	-2.0141***	-1.9786***	-1.9257***
Manufacturing	–	–	–	–	–
Construction	-0.3642*	-0.3672*	-0.3748*	-0.3679*	-0.3678*
Wholesale	0.5229***	0.5064***	0.4868***	0.5028***	0.4968***
Retail	0.0146	-0.0027	-0.0185	-0.0024	-0.0019
Accom, cafes, restrnts	0.4702**	0.4552**	0.4243*	0.4558**	0.4451**
Trans & storage	-0.0378	-0.0317	-0.0729	-0.0515	-0.0482
Fin & insurance	0.0293	0.0205	-0.0066	0.0098	0.0185
Property & BS	-0.1264	-0.1291	-0.1450	-0.1358	-0.1264
Cultural & rec.	0.1066	0.1319	0.1398	0.1126	0.1074
Personal etc	0.2759	0.2408	0.2442	0.2376	0.2307
Low performer:					
↑Mgt training (94–95 to 96–97)	0.3239**	0.1139	0.3357**	0.2702**	0.1725
↑Tech training (94–95)	0.5669***	0.6313***	0.4424***	0.5021***	0.4983***
↑On-the-job training (95-6, 96–97)	0.5050***	0.3454**	0.5052***	0.4215***	0.5576***
↑No. in training (97–98)	-0.0633	-0.3797***	-0.1758	-0.2050*	-0.1563
% employees recv:					
Structured training (97–98)	0.0143	0.1158*	0.0405	0.0467	0.0373
On-the-job training (97–98)	0.0632	0.1002*	0.0948**	0.1003**	0.0895**
High performer:					
↑Mgt training (94–95 to 96–97)	0.0977	0.3189**	0.1159	0.1536	0.3675**
↑Tech training (94–95)	0.6092***	0.5337***	0.7114***	0.7430***	0.7361***
↑On-the-job training (95–96, 96–97)	0.2831*	0.4725***	0.3316**	0.4288**	0.1449
↑No. in training (97–98)	-0.4327***	-0.0621	-0.2296*	-0.1851	-0.2826*
% employees recv:					
Structured training (97–98)	0.0588	-0.0178	0.0360	0.0163	0.0329
On-the-job training (97–98)	0.1600***	0.0900**	0.1059**	0.0959	0.1212**
Undertook/paid for R&D	1.9218***	1.9162***	1.9054***	1.9087***	1.9129***
Prop in union	-0.0439	-0.0408	-0.0401	-0.0417	-0.0418
Most employees on:					
Award	-0.1475	-0.1491	-0.1448	-0.1500	-0.1413
Indiv agmt.	0.0184	0.0155	0.0186	0.0175	0.0235
Ent. agmt. (reg)	-0.3210	-0.3225	-0.3167	-0.3187	-0.3084
—(non-reg)	-0.1447	-0.1472	-0.1411	-0.1452	-0.1406
Intends to:					
Increase prod	0.6691***	0.6742***	0.6677***	0.6730***	0.6705***
Decrease prod	0.4448*	0.4049	0.4271	0.4287	0.4161
Open new locations	0.1859	0.1690	0.1842	0.1782	0.1799
Close the business	-0.5271*	-0.5514**	-0.5356**	-0.5440**	-0.5410**
Increase exports	0.3028*	0.3116**	0.3071**	0.3042*	0.3040*
Has business plan	0.3400***	0.3320***	0.3280***	0.3306***	0.3349***

	Performance measure used in training interaction term				
	Return on equity	Return on assets	Profit margin	Profit per employee	Profit to wages ratio
Makes bus comparisons	0.2716**	0.2778***	0.2740***	0.2754***	0.278***
Exporter	0.1140	0.1051	0.1233	0.1147	0.1128
Capital/employee	-0.0007**	-0.0007**	-0.0007**	-0.0007**	-0.0007**
Wages/employee	-0.0019	-0.0023	-0.0020	-0.0020	-0.0020
Observations	3265	3265	3265	3265	3937
-2 log likelihood	927***	926***	923***	920***	1086***
Deg of freedom	42	42	42	42	42
Concordant	79.1%	79.2%	79.1%	79.0%	78.5%

Table A8: Logit estimates of the likelihood of business take-up of the internet and E-commerce, 1996–97

	Used e-commerce	Used internet	Has web site
Intercept	-3.4887***	-1.8612***	-2.9451***
Total employment	0.0128***	0.0215***	0.0284***
Total employment squared	-0.0001**	-0.0001**	-0.0001***
Age of business	0.0045	-0.0041	-0.0158
Family business	-0.0558	-0.0562	-0.0421
Industry:			
Mining	0.5425	0.8833**	0.8015**
Manufacturing	–	–	–
Construction	-0.7401**	-0.2902	-0.4792
Wholesale	0.4412***	0.1025	-0.4136**
Retail	0.3094*	-0.2608*	-1.0407***
Accom, cafes, restrnts	0.2308	-0.2197	0.3471
Trans & storage	0.4476*	-0.2207	0.4981*
Fin & insurance	0.8224***	0.9035***	-0.3473
Property & BS	0.2739	1.0240***	0.6184***
Cultural & rec.	0.3791	0.5225**	1.2880***
Personal etc	-0.9820*	-0.2792	0.4228
Increased:			
Mgt training (t)	0.5834***	0.0812	-0.0198
On-the-job training (t)	-0.0755	0.2955**	0.2877*
Other training (t)	-0.0432	0.1168	0.0098
% empioyees recv:			
Structured training (t+1)	0.1152**	0.1454***	0.1447***
On-the-job training (t+1)	0.0468	-0.0192	-0.0876*
Prop in union (t)	0.0599	-0.0656*	-0.1111**
Most employees on:			
Award	0.3552***	-0.2328**	-0.0596
Indiv agmt.	0.3434**	0.3787***	0.6034***
Ent. agmt. (reg)	0.0105	-0.5020***	-0.0194
—(non-reg)	0.4461**	-0.2048	-0.1655
Intends to:			
Increase prod	0.2248**	0.1174	-0.0319
Decrease prod	0.1305	-0.0897	-0.4926
Open new locations	0.0021	0.1957	0.0953
Close the business	-0.6127	-0.6659**	-0.7230
Increase exports	0.3460**	0.3910***	0.4528***
Has business plan	0.4781***	0.4483***	0.3067**
Makes bus. comparisons	0.8612***	0.1201	-0.0485
% part-time	-0.2007	-0.2331	-0.6625**
Exporter	0.0834	0.5689***	0.1877
Profit/employee	2.4×10^{-5}	-0.0001	0.0001
Wages/employee	0.0048*	0.0169***	0.0079***
Wages/total costs	-0.2827	-0.5471**	-0.4089
Observations	3903	3903	3903
-2 log likelihood	567***	1034***	484***
Deg of Freedom	36	36	36
Concordant	77.2%	78.6%	78.2%

NCVER

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ISBN 0 87397 737 8 print edition
ISBN 0 87397 738 6 web edition